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OBSERVATIONS ON SOME OF THE PRINCIPLES OF ARTIFICIAL SUN TREATMENT.

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General Considerations.

The treatment of a disease by means of actino-therapy endeavours to assist and accelerate those natural forces of the body which are utilized to effect healing of diseased tissue. Reviewing methods of treatment from a general point of view, treatment of disease may be approached by two methods : (1) Direct or local treatment; (2) general treatment. Local treatment aims at the complete removal of an area of diseased tissue by radical means or by a direct destruction of the agent responsible for the cause of the disease. In this general classification, the accessory measures usually adopted—such as the correction of deformity, the drainage of abscesses, and the ingenious methods devised for minimizing the amount of damage—must be included. All "general treatment," whether it involves such measures as diet, rest, medicine, hormones, vaccines, are all directed to attenuate the powers of the blood, and to assist the patient to utilize the resources at his disposal for a rapid recovery to "good health."

The sanatorium treatment of patients who are suffering from tuberculous disease has proved to be a remarkable success, mainly due to the great efforts of many pioneer workers, such as Bernhard, Rollier, Hill, Gauvain, and Pugh. All these workers have up to recent years advocated the use of natural sunlight and open air for the treatment of many chronic inflammatory diseases.

Finsen originated a method of local treatment for lupus by means

of light. In his early experiments he utilized both natural sunlight and artificial sources of light—*i.e.*, carbon arc-lamps. By means of large rock-salt and quartz prisms, he concentrated light of great intensity upon the sites of diseased tissue. His results were very promising, and as a result of his researches the Light Institute at Copenhagen was founded, and treatment by means of phototherapy has gradually evolved to take an important place in therapeutics of the present day.

Phototherapy and actino-therapy can be defined as the utilization of the radiant energy of the sun's rays in the treatment of disease. Realizing how little is known about the exact nature of radiation, it is not surprising to acknowledge that the action of the sun's rays on the animal body is still an unsolved problem. The researches of innumerable pioneer workers have proved that radiant energy is transmitted in the form of wave motion, through a hypothetical medium called "the ether." The direction of the wave is transverse, and the velocity of transmission corresponds to 186,300 miles per second. A wave-length is defined as the distance between any two corresponding points on successive waves, the distance being measured in the direction in which the wave travels, and is expressed in terms of Ångström units, which compounds to $\frac{1}{10.000.000}$ of a millimetre.

Although the term "light" is used vaguely to express the visual sensation, radiant energy involves a great variety of types of radiation, differing in the size of the wave-length and in the frequency of vibration. The physiological functions of many of these types of radiation are still in the realms of hidden science; their utilization is being gradually developed into the battle of life and nature. The following table indicates the general classification of the types of radiation recognized at the present time:

TABLE INDICATING CLASSIFICATION OF TYPES OF RADIATION.

	λ.
Hertzian	5,000,000
Intermediate	200,000
Infra red	12,000-7,700
VISIBLE.	
Red	7,700-6,200
Orange	6,200-5,900
Yellow	5,900-5,600
Yellow-green	5,600-5,300
Green	5,300-5,000
Blue-green	5,000-4,700
Blue	4,700-4,300
Violet	4,300-3,900
ULTRA-VIOLET.	
Near	3,900-3,000
Long and short	3,000-2,000
Schumann	2,000-960
Radium	
X ray	

Physical and Biological Reactions.

Clark Maxwell[1] has described light as an electro-magnet disturbance propagated with finite velocity. The basis of matter is the atom, each of which consists of a positive nucleus bound to a number of electrons carrying a negative charge. When radiations are absorbed by the atom, liberation of negative electrons under the influence of electro-magnet waves are produced. This produces an alteration in the atomic structure, by the addition or removal of negative electrons, and gives rise to a number of specific photo-electric reactions. Lénard[2] has suggested that electrons vibrate along a line attracted to some central force at a varying distance. The frequency of vibration of the electron responds to a train of light waves bearing a similar frequency, and at a certain critical period the amplitude increases to such an extent, that the electron breaks away. Light, therefore, influences the state of stability of the atomic system and results in the ejection of electrons.

Each element possesses its own specific action, and only manifests electrical changes with light bearing the same resonant frequency as its electrons. Lénard showed that metal plates irradiated *in vacuo* emitted photo-electrons and carried a positive charge. The velocity of emission of electrons was influenced by (1) the intensity of light; (2) the frequency of the exciting light; (3) the nature of the illuminated surface.

From this very rapid and general summary, it is obvious that light is first absorbed and gives rise to chemical or other reactions. The range of these changes is very extensive, but it is important to realize the selective process which always exists in these reactions. The whole existence of the living organism depends upon the absorption of radiant energy — 1 sq. c.c. of living matter exposed to the sun receives sufficient energy per minute to raise the temperature of 1 kilogramme of water 1° C.

The biological reactions produced by light vary considerably with the nature of the wave-length of light which is absorbed. From the practical application, three big groups of rays are recognizable as being distinct in their reactions, but are often difficult to isolate and separate from each other. These three groups are (1) the heat rays, (2) the luminous rays, and (3) the ultra-violet rays.

The heat rays consist of a number of radiations from 12,000-7,700λ. Heat is carried from one medium to another by radiation, conduction, or convection, and in this way the temperature of a body can be raised. The rate of all chemical reactions is accelerated by heat. In the living tissues the heat rays produce a primary stimulation and excitation, followed by fatigue and death of tissues by causing a change in the physical state of proteins—*i.e.*, coagulation. All bactericidal effects

produced by means of heat are due to death by coagulation of protein. There is a biological mean of temperature which is a constant for the different types of proteins, living cells, and organisms.

Heat rays produce a sensation of warmth when applied to the body surface. This is due to the stimulation of the heat and cold receptors in the skin. As a result of this stimulation, vaso-dilation and acceleration of the capillary circulation develops, followed later by sweating. With increase of the heat stimulus, capillary stasis and erythema develop, giving all the characteristic appearances of a burn. The zone of erythema extending beyond the area of skin irradiated, always corresponds to the posterior nerve root distribution of the area of skin. There is no prolonged latent period between the time of irradiation and the reaction resulting. With further increase of the intensity of the source of heat, blistering and severe burns are produced, giving rise to painful sensation, tissue destruction, and inflammatory changes. The pigment of the skin—melanin—absorbs heat rays. In erythema *ab igne*, pigmentation of the legs occurs as a result of exposure to heat rays of coal-fires and gas-stoves. The pigmentation is characterized by mottled macular areas of erythema and pigment. Often a mottled macular erythema is observed directly after a prolonged exposure of the body to the carbon arc. Hertel[3] has stated that he has been able to demonstrate bactericidal effects with infra red rays irradiation, distinct from the temperature effects. Professor Hill and the writer have been unable to confirm this phenomenon. The bactericidal action of the infra-red rays is due to heat coagulation of the protein in the tissues.

The luminous rays are a series of radiations from 7,700-3,900λ. This group of radiations are the great factors involved in colour vision, and form the visible portion of the spectrum. Upon analysis luminous white light or sunlight consists of a combination of red, orange, yellow, green, blue, and violet rays, ranging from 7,700-3,900λ. Besides the important factor of producing the sensation of vision, each group of radiations, no doubt, possess some marked psychological effect. The study of chromatology is in the infancy of the development of the visuophysic responses. Luminous rays have slight photo-chemical powers in the fact that they sensitize the photographic plate. The green, blue, and violet rays are the most sensitizing of the whole group. Pohl and Pringheim[4] have shown that the alkaline earth metals develop photo-electric properties, when irradiated *in vacuo* with the luminous rays.

Besides demonstrating the general effect of white light, there exists a selective photo-electric effect with special metals, potassium for blue rays, sodium and rubidium with yellow rays. The luminous rays in themselves have no bactericidal power, and irradiation of the skin surface with pure luminous rays, if heating effect is removed by water-cooling, cannot produce erythema and its sequelæ. When tissues are

combined with substances like erythrosin and eosin, known as photo-sensitizers, bactericidal activity can be demonstrated by irradiation with the luminous rays. This is claimed to be due to a change in radiation emission, as a result of the action of the rays on the sensitizer. Carl Sonné,[4] and later Professor Hill and Campbell,[5] have been able to show that the luminous rays penetrate the skin surface to a greater depth than the infra-red heat rays, and that the luminous rays can heat the tissues 3 to 4° C. above that of the skin temperature at a depth of 4 to 5 mm. Sonné claims that the ameliorative effect of light depends upon this heat stimulus, which causes exudation of round cells and lymph, and increases the antigenitic powers of the blood. In a further communication he carried out some experiments on rabbits, in which he found that the luminous rays increased the resistance to diphtheria toxin. Dr. Hartley[6] has found no change in the quantitative estimation of anti-toxin content of the blood serum, after irradiation with the luminous and ultra-violet rays, and cannot confirm Sonné's experiment.

The ultra-violet rays consist of a number of radiations which are best classified under three groups, according to their transmission through media :

Long.—(1) Ultra-violet radiations transmitted through window-glass (3,900-3,000λ).

Short.—(2) Ultra-violet radiations transmitted through the atmospheric, but absorbed by glass (3,000-2,000λ).

(3) The Schumann region, or extreme ultra-violet (2,000-800λ).

This group of radiations have very marked photo-chemical, photo-electrical, and photo-abiotic properties. The intensity of reaction depends upon the amount of absorption. The radiations which are absorbed by living tissues and protein are those ranging from 3,000λ, and the changes produced are increased with the shorter radiation. The ultra-violet rays are sensitive to the photographic plate ; this was the original method employed in their discovery and further development. When metals are irradiated *in vacuo* with ultra-violet light they develop a positive charge and liberate negative electrons ; the rate of emission is directly proportional to the intensity of irradiation and inversely proportional to the frequency. In living tissues the ultra-violet rays have marked abiotic powers, they are extremely lethal to many organisms and bacteria, and, again, the lethal effect is a factor of intensity and frequency of radiation. The penetration of the ultra-violet rays becomes progressively less with decrease in the wave-length, which signifies that penetration of the skin decreases with shorter wave-lengths.

When the skin is irradiated with ultra-violet rays it has been shown to demonstrate marked fluorescence. In all ultra-violet reactions photo-electrical changes occur in the irradiated media, which cause changes

in the H ion concentration. The rays which have the most marked bactericidal power are those shorter than 2,900λ. The shorter the radiation, the more active is the bactericidal power which results. By the action of the ultra-violet rays, emission of electrons and ionization of photo-electrons occur; this gives rise to the formation of photo-chemical compounds, producing changes in the molecular structure, and death by aggregation. The photodynamic sensitization of substances so that they react towards visible light, in the presence of certain dyes (eosin and erythrosin, etc.), is explained in the same way; the threshold of the light sensitive substance is shifted to longer wave-lengths, producing photo-electric changes with the longer radiations.

The ultra-violet rays destroy toxin and antitoxin and most of the common enzymes. The rays are powerfully absorbed by the blood and all protein tissues. Ultra-violet rays are detected by means of (1) the spectroscope and photographic plate; (2) many electrical methods, by means of photo-electric cells; (3) biological methods, by lethal action on bacteria; or (4) by chemical methods, such as changes in the Ph. of a solution of acetone (or acetone methylene blue). When the skin is irradiated with the ultra-violet rays, after a latent period of a few hours, depending upon the intensity and time of irradiation, erythema is developed. This, unlike heat erythema, is circumscribed to the area irradiated. It is followed by intradermal œdema and later desquamation and pigmentation. When involuntary muscle is irradiated, reflex contraction occurs. Stasis of the capillary circulation occurs with the ultra-violet radiation. The albumin and globulin of protein are coagulated after prolonged exposure to the ultra-violet rays. The cornea of the eye and the human skin are opaque to all radiations shorter than 2,500λ. It is only just conceivable that the ultra-violet rays may penetrate to the most superficial capillary plexuses of the skin. The erythema produced appears to be a response to some change in the epithelial cells, as a result of ultra-violet irradiation.

In all these light reactions, it has been a matter of great difficulty to isolate the ultra-violet rays, separate from the luminous and heat rays. Most experiments have been performed by a process of elimination, whereby the heat effect has been removed by irrigation with water, and control experiments have been carried out whereby the ultra-violet rays have been filtered off by means of a glass or quinine filters. By these means it has been shown that many of these photo-electrical, photo-chemical, and photo-abiotic changes are to a greater degree specific to ultra-violet radiations. In studying these ultra-violet reactions on living cells and on the skin, it has been shown that heat rays or heat effects of the luminous rays activate and accelerate the biological action of the ultra-violet rays. It is impossible to produce any marked erythema of the skin unless ultra-violet rays are present in the source

of irradiation (*i.e.*, other than heat erythema). The ultra-violet rays develop photo-electrical changes, which give rise to chemical reaction within the molecular structures; this chemical reaction is accelerated by the luminous and heat radiations.

Although it has been stated that the luminous rays help to accelerate ultra-violet reactions, Hess has shown that the red luminous rays delay the cure of rickets produced by ultra-violet rays. Professor Hill and the writer had some evidence that the red rays kept infusoria moving actively for a longer time when exposed to the ultra-violet rays, but did not delay the killing time. Argyll Campbell and Hill found no evidence of interference, using the circulation in the mesentery for observation of lethal effect.

When the skin is exposed to a source of light—whether an artificial source or sunlight—the ultra-violet rays primarily start a chemical change in the epithelial cells, which is still further accelerated by the heat and luminous rays. In all these cases the velocity and intensity of the reaction will depend primarily upon: (1) The intensity and nature of ultra-violet radiation present: (2) the intensity of the chemical accelerators present (*i.e.*, heat and luminous rays); (3) the distance of the source from the irradiated substance; (4) the nature of the irradiated skin.

The original methods of utilization of artificial light devised by Finsen, and later modified by Alex Reyn, have progressively opened up this new field in therapeutics. The Finsen-Reyn lamp consists of a carbon arc—the electrodes placed at right angles to each other—and utilizes a current of 20 amperes and 50 volts. By this means a concentrated beam of intense light is produced. This light is focussed through a series of quartz lenses and on to a quartz applicator, which has a current of water flowing through so as to absorb the heat rays. The resulting radiations emerge as a convergent beam of short focal length. The heat effect is very pronounced unless great skill is adopted in the method of applying the lamp to the lesion. The lamp emits much heat rays and luminous rays of a very great intensity, but the ultra-violet rays are comparatively poor, as much of the intensity is lost through bad focussing. Ultra-violet rays are brought to a focus which is shorter than that for the luminous rays. The lethal action on infusoria is forty minutes at 18° C. Finsen's object in treatment with this concentrated light was to produce direct destruction of the tubercle bacillus and healing. Since ultra-violet rays are absorbed by the superficial layers of the skin, and do not penetrate much more than $\frac{1}{10}$ inch, it is not possible to conceive any direct bactericidal effect of the ultra-violet rays. The longer ultra-violet rays may produce vaso-dilatation, acceleration of the capillary blood flow, and finally capillary stasis. According to R. Gassul's[7] investigations of lupus skin irradiated

with Finsen light, he showed vessel expansion, hyperæmia, leucocyte infiltration, necrobiosis in the nucleus of the plasma or granulation cells; the giant cells showed pyknosis and chromatolysis. The lupus tissue was destroyed and replaced by connective tissue cells and fibrous tissue. Carl Sonné ascribes this phenomena to the result of the heating effect on the deeper layers of the skin by the luminous rays. Klingmuller and Halbersbladter[8] irradiated lupus nodules for seventy minutes with a Finsen lamp. After irradiation this was then injected intraperitoneally into guinea-pigs, with the result that many of the animals died from tuberculosis. Other experiments of irradiated areas of skin injected with tubercle bacillus with concentrated light did not prevent the general infection of tuberculosis.

In a series of experiments which were carried out during the last few months by Dr. Leonard Colebrook, Professor Hill,[8] and myself, the effects of irradiation of the skin on the bactericidal power of the blood were investigated. Heat rays, when used extensively, so as to produce a counter irritation and marked reaction (*i.e.*, 44° C.), increased the killing power of the blood. The luminous rays were without effect. The ultra-violet rays gave a very marked increase in the hæmo-bactericidal power of the blood, from one to three hours after radiation. Mustard poultices gave a similar result when applied for one and a half hours to the shaved abdominal skin of rabbits. There is, therefore, some product developed as a result of irradiation, producing an erythema, and increasing the bactericidal properties of the blood.

Following the exposure to ultra-violet radiation, erythema, œdema, blistering, and pigmentation may result. Sequeira[15] has found that in the treatment of lupus by means of the Finsen-Reyn lamp it was possible to heal one area, but in many cases during the course of treatment a new focus developed, and it was difficult to battle with the increasing spread of the lesion. There is no conclusive proof as to the exact process which develops as a result of local light application. Jesionek[9] gives credit to the serous saturation of the tissues following irradiation; Kush attributes the beneficial actions to the hyperæmia. W. Neumann,[10] however, states that the Finsen light irradiation causes a marked infiltration of lymphocytes; the fat decomposing ferments of these cells are able to dissolve the fat membranes of the phagocytised tubercle bacillus, and they are injured in such a way that they have less resistance than the normal organism.

From all these observations the one outstanding fact is, that the local treatment with focussed Finsen-Reyn lamps produces a marked hyperæmia, by dilatation and acceleration of the capillary circulation. This persists for some length of time, and greatly improves the circulation at the site of the lesion. Many similar results can be obtained by means of the water-cooled mercury vapour lamp.

The further development of light therapy has indicated many beneficial results by the general exposure of the naked body to sunlight and cool air. Artificial sources of light—the open arc and quartz mercury vapour lamp—have been utilized to obtain similar results. This general exposure of the body to light results in the production of erythema, followed later by desquamation and pigmentation of the skin.

Hess[11] has shown that rats fed on a ricket-producing diet, did not develop the disease after a daily exposure to the mercury vapour lamp for two minutes. The clinical results of sun-bath exposure and of general exposure to artificial sources of light, in cases of chronic disease, have given many excellent results. The erythema produced is essentially due to the ultra-violet radiations. Professor Hill recently demonstrated that if the skin is irrigated, so that the luminous rays cannot heat it, and the ultra-violet radiations are filtered off by means of glass, or better still by a solution of quinine, no erythema develops. The ultra-violet rays act by causing better absorption of phosphorus and calcium salts from the alimentary canal (A. Webster).

The erythema produced by ultra-violet rays is accentuated by the heating effect of luminous and infra-red rays. But it must be remembered that in all these cases the extent of the erythema depends upon: (1) The intensity of the source of radiation; (2) the quantity and quality of ultra-violet radiation; (3) the intensity of the heat and luminous rays; (4) the distance from the sources irradiated; (5) the susceptibility of the skin of the person.

Rollier and Christen[12] maintain that the pigment of the skin is a transformer, and acts as an optical sensitizer, absorbing luminous rays and transmitting shorter radiations. In Rollier's method of treatment, exposure to light is carried out very slowly and cautiously, so as to avoid erythema and to produce very gradual pigmentation. Melanin is not fluorescent, and no experimental evidence is yet at hand to prove that melanin is an optical sensitizer.

Reyn states that cures follow most readily when skin erythema is produced after irradiation. Melanin presents an important defence mechanisn against light rays of all wave-lengths. After pigmentation, patients can be exposed to a much more drastic irradiation. The parallel line between healing tendency and increased pigmentation has by no means been universally accepted. Reyn has shown that tuberculous patients who pigment slowly, or not at all (non-pigmenters) after irradiation, none the less exhibit excellent therapeutic results, in contrast to Rollier, who maintains that such patients only make poor progress.

In a series of experiments in which the effect of radiation on the bactericidal power was investigated, it was shown that an erythema

dose often produced a rise in bactericidal power. Albino rabbits gave this response as well as normal rabbits. Recently, in a number of cases in which patients have been pigmented, the rise in bactericidal power is still obtained after irradiation; but in these cases a marked erythema developed after radiation. The problem of the function and significance of melanin is still obscure. The nature of the colour of the pigment that develops in the human skin appears to vary with the source of radiation, and also to some extent with the nature of the skin irradiated. The sun gives rise to a dark brown-black pigmentation. The Finsen arc also gives rise to a dark-coloured pigment. The long white flame arcs and tungsten arcs give a reddish-brown pigmentation, the mercury vapour lamp a pale yellowish-brown pigmentation. Patients who have been exposed to the sun and are black-skinned gradually lose their pigment, and become a lighter brown on exposure to the mercury vapour lamp or open long flame arc. Long and short ultra-violet radiation may be able to cause a reversal of the enzymic action which produces the pigment melanin from its precursors, tyrosin and phenyl-alanin. Jesionek suggests that the pigment is split up by the light and taken up into the blood, where it exerts a therapeutic action. It must also be remembered that marked changes in capillary circulation occur as a result of irradiation, and that the capillaries become more superficial. It is conceivable that there may be a direct action on the blood by means of the longer ultra-violet radiations.

In some investigations on the bactericidal power of the blood it was found that an excessive dose of light, producing violent erythema, will cause damage and lowering of the hæmobactericidal power. Therefore, although there appears to be some evidence to demonstrate a connection between erythema and the bactericidal power, the dosage of light must be somewhat carefully graded. It must be remembered that the luminous rays have the power of heating the deeper tissues 4° to 5° C. In many chronic inflammatory diseases there are disturbances of the heat-regulating mechanism, and the patient has an oscillating temperature of 101° to 102° F. If a source of light of great intensity in heat and luminous rays is employed, the temperature may be raised to 104° to 105° F., giving rise to pyrexia, rigors, and general malaise. The hot sun-rays and arcs should not be employed in such cases, but the cool early morning sun or the mercury vapour lamp would be the more suitable.

In investigating the bactericidal properties of the human blood before and after radiation with ultra-violet rays, a rise in the killing power of the blood is usually observed. The average percentage of bactericidal power tested against staphylococcus, streptococcus, and pneumococcus varies with different patients, but in many cases it is

high—about 85 to 90 per cent. Radiation will increase this to 95 or even to 100 per cent. In the acute infections, such as septicæmias, the bactericidal power is much lowered—*i.e.*, 30 to 40 per cent.; the effect of radiation in these cases is still being investigated. Although the result of the investigations are not yet complete, it is difficult to determine the value of this bactericidal test as a means of controlling light dosage. The high bactericidal properties of human blood in chronic inflammatory diseases, make correct interpretation of results difficult. However, decrease in the hæmobactericidal power after light treatment should be regarded as a sign for the necessity of cautious dosage or cessation of treatment. The direct exposure of defibrinated blood[13] *in vitro* to ultra-violet rays lessens the bactericidal power of the blood. An intravenous injection of the "irradiated blood" causes a marked rise in the bactericidal power of the animal's blood, which persists for some hours. It has not been possible to fully explain the mechanism involved in this phenomenon; irradiated corpuscles appear to be essential to produce it, as an injection of irradiated serum gives rise to no marked change.

Lamps for Artificial Sun Treatment.

There are a very great variety of lamps now being utilized for artificial sun treatment. The fact that they are usually operated by a single switch and that they emit a brilliant light, often "blinds the eyes" as to their genuine value in ultra-violet rays. The two types of lamps utilized are carbon arc and mercury vapour lamps. It must be stated that the radiation emitted from a lamp depends greatly upon the amperage and voltage between the two electrodes, and the nature of the electrodes—*i.e.*, the carbons and the mechanism of the lamps. It is, therefore, obvious that before being able to utilize these lamps it is necessary to be able to have some ready means of measuring the nature and intensity of radiation. The spectroscopic methods are exhaustive and tedious to carry out, and do not give a true value of biological action.

Professor Hill, Webster,[14] and myself, have originated a method for determining the intensity of a lamp and to fix biological standards to assist in light dosage. A source of ultra-violet light is tested in three ways: (1) The time taken to kill infusoria enclosed in a quartz water-cooled chamber; (2) the time required to bleach a standard solution of acetone methylene blue; and (3) the action of the normal white skin to the source of light. From a series of observations on the reaction of the normal skin to light, twice the time required to kill infusoria will produce a mild erythema, which disappears after a day or so.

The different areas of the skin of the body vary in their sensitiveness to light. The inner side of the arms and thighs and the popliteal spaces are the most sensitive. As a general rule, it is advisable to test

the sensitiveness of the skin. This can be done by exposing three small areas of the abdominal skin, 2 inches above the umbilicus, to successive doses of light corresponding from two to six infusoria killing doses, or to three intervals of time, say $3\frac{1}{2}$-5-$7\frac{1}{2}$ minutes. Individual skins vary in colour, and the dark skins require longer doses of light than fair-skinned and blue-eyed people. Some sallow-coloured patients show very little skin erythema with the first treatment with the mercury vapour lamp, but react later if given three to four doses of the arc lamp. The quality of erythema produced by radiation with the arc and mercury vapour lamps, may be estimated by measurement with the Lovibond skin tintometer. The intensity of erythema may be classified clinically as: (1) Erythema which is just visible and usually disappears in one to two days; (2) erythema which persists three to four days followed by desquamation and pigmentation; (3) erythema producing œdema, a bluish flush, tenderness on palpation, followed later by vesicles—petechial hæmorrhages—and finally desquamation; (4) erythema producing blistering and its sequelæ.

The dosage with light is still a matter of great controversy. The Copenhagen school expose their patients for two hours or more, and allow them to pigment. The whole question varies greatly with the individual behaviour of the skin of the patient and the type of lamp employed. The treatment should be controlled by the erythema produced. In many cases it is advisable to test the individual sensitiveness of the skin, by means of the "test dosage armlet," by means of which three small areas of abdominal skin are exposed for three successive exposures. The erythema resulting on the following day gives some guide of the sensitiveness of the skin to light. In many cases of doubt when treating sick or light sensitive patients, the estimation of the bactericidal power of the blood before and after light may be a great help in early stages of treatment. It must be recognized that the dosage of light is an all-important factor, and must be cautiously controlled when treating sensitive or sick patients. The whole mechanism of reaction of the skin and pigmentation is still a matter requiring further investigation. But treatment should be guided by the clinical signs and symptoms of the patient, and dosage should be controlled by a careful study of the skin reaction. The early desquamating skin is very opaque to the ultra-violet rays, and treatment should be arrested for a while during the stages of desquamation, as the new skin is very sensitive to light, and may produce blistering and a hæmorrhagic petechial rash.

For collective treatment the type of arc most suitable for hospital use is one which is automatic in regulation and focussing, and steady in its flame. Tungsten is useful for low amperage arcs (5 to 10 amperes), as it increases the ultra-violet energy. In high amperage arcs the

length of the flame is controlled by the voltage. The Copenhagen arc is of the short flame type, and has a current of 75 amperes, 40 to 50 volts giving 2·8 to 3·5 kilowatts energy. The long flame arcs are worked at 30 to 35 amperes and 65 to 80 volts giving 2 to 2·8 kilowatts energy. White flame carbons appear to give good skin reactions, are more economical to use, and emit less fumes than tungsten. It is not necessary to utilize tungsten in the high-power arcs. The total ultra-violet energy of the Copenhagen arcs and the long flame arcs is practically identical, the latter being somewhat more powerful and cheaper to run.

There are two types of mercury vapour lamps: (1) the vacuum type, and (2) the atmospheric type. The vacuum lamp loses power with use, as the vacuum is reduced, and the energy is not a constant factor. The Atmospheric burner (made by Kelvin, Bottomly, and Baird) is an English-made lamp, and does not deteriorate with use. The latter is an important point when light dosage is considered.

Classification of Cases and Technique of Clinical Application.

The type of cases most amenable to treatment are the chronic inflammatory diseases. Many skin diseases appear to improve rapidly, especially lupus vulgaris, psoriasis, and staphylococcal infections. Many of the secondary anæmias respond rapidly to treatment. Tubercular diseases of the glands, bones, and lungs make slow, steady progress. The general routine of treatment consists of the gradual exposure of the whole body to light. The chest and back are first exposed, followed by alternate doses to the legs, and finally the whole body is irradiated. The length of the exposure depends upon the individual susceptibility of the skin until the time of pigmentation, when the whole body can be exposed for longer periods. In the early stages, open exposed lesions of the face and body, ulcers, and sinuses are best covered and protected from the light, so as to avoid focal and general reactions.

The cases of pyrexia and light sensitive patients—*i.e.*, non-pigmenters—require the most careful dosage. Excessive dosage of light will at times do a serious amount of harm and stir up a generalized infection.

Recumbent patients may be treated by an ingenious method devised by Professor L. Hill, by which a bed cradle, containing two tungsten filament lamps in quartz envelopes, can be placed over their bed. This emits a very mild amount of ultra-violet light, and the patients can be exposed from six to twelve hours during the day. The treatment is beneficial in cases of senile gangrene, arthritis of joints, and some mild pyrexial types of tuberculosis.

In many of the chronic inflammatory diseases, progress during the course of light treatment is slow. This is a result of the extensive disorganization of tissues, the massive fibrosis, and inflammatory changes that have occurred. The bactericidal properties of the blood may be quite good, but in such cases the circulation to the site of the lesion is very poor, and the blood may never directly reach the site of the disease. This particularly applies to many of the chronic sinuses around the site of tubercular lesions in bones and joints. Another factor, which may be of the greatest importance, is the results of the "metabolism of the infecting organism"—anaphylactic reactions due to sensitization to bacterial toxins.

Although the progress with light treatment is in many cases slow, there is sufficient evidence at hand to demonstrate its tremendous scope for wide utilization in the treatment of disease.

The massive disorganization of tissues and the deformity of structure which occur in chronic infections are, indeed, a colossal handicap to rapid progress. The *early* treatment of disease is the criterion of all the modern therapeutics. This involves early diagnosis and rapid dispatch to hospitals, sanatoria, and tuberculosis centres, where patients can readily get immediate and skilled treatment.

Many of the phenomena of light are still very perplexing. The field of research is open wide. It is only by the closest observations and truthful examinations that progress can be made by linking together the discorded facts which have been briefly tabulated and discussed.

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A REVIEW OF PRESENT-DAY SURGICAL TREATMENT OF PULMONARY TUBERCULOSIS.

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The principal object in the treatment of pulmonary tuberculosis is to secure rest for the affected part and to promote healing by the formation of fibrous tissue. If by the ordinary means and régime the active process does not develop, then other methods must be tried. One of the surest ways of arresting intractable disease, and bringing about cure, is by inducing collapse of the affected lung. The most simple and usual means of doing this is by the procedure known as artificial pneumothorax. We shall not, however, deal with this subject here, but rather consider the management of those cases where collapse-therapy is indicated, and where attempts at producing an artificial pneumothorax have failed. We shall also refer to cases where an attempt to induce artificial pneumothorax would be considered dangerous and inadvisable. As a general rule one may say that if after three or four months' treatment by ordinary means, activity of the morbid process and fever still persists, it is of no great use to wait longer, but an attempt should be made where the disease is reasonably unilateral to bring about a collapse by the production of a pneumothorax. In every case it is always wise to make a mental picture of the evolution of the disease, and the insidious microscopical spreadings of the lesions, rather than to dwell only on the present extent and form of the morbid processes as revealed by physical signs. If in any case the production of pneumothorax is impossible, then the question of other forms of surgical interference must be considered. The varieties of surgical treatment of pulmonary tuberculosis other than by the induction of an artificial pneumothorax are *plombage*, *thoracoplasty*, and *phrenecotomy*, and these are the methods which we desire to discuss in this paper.

Pathological Considerations Relating to Surgical Measures.

The first aim of the surgeon in dealing with a case of pulmonary tuberculosis is to obtain the suppression of the diseased focus by direct

attack. Total or partial resection of one or more lobes is still an isolated incident. Roux and Mickulicz have obtained some magnificent successes with this method, but these interferences are actually too serious, or their results too uncertain, to become generally employed, and we only mention them in passing. In a similar manner we may also refer to the employment of direct drainage of cavities from the outside. The modern surgical treatment of pulmonary tuberculosis consists above all in immobilization of the diseased parts by collapse. This method is based on the anatomico-pathological fact that a tuberculous lung tends to produce fibrous tissue, and moreover has a distinct tendency to undergo arrest, processes being put in operation which favour sclerosis of the lung-tissue. Nature, in fact, endeavours to obtain the same results as follow the production of an artificial pneumothorax, although by different means. This reduction of the volume of the diseased lung by diminishing it, practically destroying its functions, and putting the organ at rest, permits the elastic fibres and lung-tissue to contract more completely by exercising an exterior compression, and facilitates the retraction of the lung on its hilus, all of which favours the formation of fibrous tissue. This is the process on which surgical collapse-therapy is based. In this manner all cavities, etc., and their pathological contents in the affected zone are diminished, the cavities become invisible on the radiograph, or only appear as flat clefts. However, their shrinking can only be complete if the fibrous walls are not too sclerosed, and have not acquired a consistence hard enough to resist the exterior compression and the retraction of the lung-tissue.

Besides the mechanical effect produced by this procedure, the collapsed lung still remains the seat of various morbid processes, such as stagnation of blood-circulation and stasis of lymphatic circulation. The collective result of these phenomena is the development of a considerable amount of fibrous tissue, which replaces the normal healthy parenchyma of the lung. This fibrous tissue surrounds the tuberculous foci, encapsulates them, shuts them off and isolates them, and sometimes even replaces them. These transformations have been proved to be more pronounced after extrapleural thoracoplasty than after pneumothorax, as has been shown by Jehn and Sauerbruch, who proved this point by a series of autopsies and microscopical examinations. It is worth noticing, however, that the bronchial tree does not take part in this fibrous tissue production, and that the small bronchi, the walls of which contain no cartilage and which are still supple, are alone affected. The massive production of antibodies consequent upon the penetration into the circulation of bacillary products set free by this compression and retraction of the lung also plays an indirect rôle in the formation of fibrous tissue. This rôle depends especially upon the

power of the reaction of the patient—that is to say, upon his general capability of resistance. Bearing in mind these considerations, let us enunciate the following principle—*i.e.*, that surgical collapse of the lung augments the quantity of fibrous tissue, and increases the rapidity and extent of its production, and therefore tends to promote the rapidity and the stability of the so-called "cure" of the tuberculous patient.

The production of surgical collapse of a tuberculous lung at present comprises three main procedures: (1) *Artificial pneumothorax;* (2) *extra-pleural plombage;* (3) *phrenecotomy;* (4) *thoracoplasty* (extra-pleural).

Extrapleural Plombage.

The production of extrapleural plombage aims at attacking directly the actual focus of the tuberculous disease. It seems to be a logical step to seek for means whereby the diseased focus alone may be kept at rest without interfering with the healthy parts of the lung involved. Plombage has the advantage that one can carry it out at the situation chosen and to the extent that is required, but unfortunately the results hitherto obtained by this method have not been encouraging. Whether one employs organic plombages—that is to say, fats, muscular substances, etc.—or, on the other hand, inorganic bodies such as paraffin, gauze pluggings, or dilatable indiarubber bags, the extent of the collapse produced is insufficient, and does not affect with any certainty those parts of the lung already microscopically affected with disease. It is only possible to arrive at this condition by the total collapse of the attached lung. Again, if organic substances are employed, they are not infrequently more or less slowly absorbed, and as regards the inorganic substances, paraffin is frequently evacuated, while the "ballons" of caoutchouc certainly cannot be tolerated for ever.

If these agents are done away with too soon, as by spontaneous absorption or by exclusion, the lung substance subjacent commences once more to resume its functions and to become air-containing. It expands and contracts and so tends to return to its original volume. No doubt some fibrous tissue will have had time to develop in the compressed part during the period of duration of the plombage, and probably the recovery will have been materially aided, but often only temporarily and in an insufficient manner. The pathological processes then start again in the lung, and sometimes there may also persist fistulæ when the plombage has caused the external rupture of a subjacent cavity. Although in many instances life has been prolonged by the adoption of plombage, it cannot be recommended as a general practice. It must also be stated that this procedure is even much less logical than appears on first consideration, for the anatomico-pathological extension of the tuberculous processes in the diseased lung is always

more considerable than either clinical or radiological examination would lead one to expect. In other words, at the moment of performance of this operation, there exists no certain means whereby the real extent of the tuberculous lesion may be estimated. It follows therefore that one cannot give to this operation the exact dimensions necessary, and so inevitably for this reason there must be many unsuccessful cases.

The Technique of Extrapleural Plombage.

We can now proceed to describe the technique of extrapleural plombage, such as has been performed for the arrest of apical tuberculosis (Tuffier's method). An incision 6 to 8 centimetres long is made from the outer border of the sternum, 2 centimetres below the clavicle and parallel to it, reaching beyond the upper edge of the third rib. A flap is then raised exposing the second rib, the intercostal muscles are exposed, and between them and the pleura a grooved sound is inserted. The muscles are then incised along this sound. The parietal pleura is next carefully separated from the second rib. The rib is then resected close to its sternal attachment as far as two fingers' breadth outside this point. In the opening thus formed one can see the pleura, which is generally adherent. With the pulp of the index finger, slowly and carefully, and without pressing on the pleura, the separation of the parietal layer is continued until the operator arrives under the thoracic dome. The stripping is then continued behind the apex and finally inwards towards the mediastinum. This stripping process is especially difficult behind the apex and towards the mediastinum because of the depth and firmness of the adhesions with the vertical column and the ribs. If the lung is not sclerosed or infiltrated with massive tuberculous deposit, the separation of the pleura produces at each inspiration a retraction of the lung, and there is thus created between the thoracic wall and the pleura a cavity into which air enters and is expelled at each full movement of respiration. In fact an extrapleural pneumothorax is produced open to the outside and very susceptible to infection. In the hope of circumventing this infection, Tuffier, during the stripping process, is in the habit of interposing between his finger and the parietal layer a thin sheet of sterilized silk, in order, if possible, to prevent contact between the air and the pleura. The separation having been terminated, the extrapleural cavity is filled with the substance to be used for the plombage. It is necessary afterwards to suture most carefully, and layer by layer, the intercostal muscles, the periosteum, the pectoral muscles, and finally the skin. If the pectoral muscles alone are sutured, the plombage material insinuates itself between these muscles and the ribs, the compression of the lung is lessened, and there may be produced towards the skin a fistula, thereby causing infection of the cavity and through which the plombage

is ultimately eliminated. However, in the practice of pulmonary surgery as it is generally carried out at the present day, extrapleural plombage as an operation in itself has been practically abandoned, but it can occasionally be utilized with advantage in combination with artificial pneumothorax, with thoracoplasty, or even with phrenecotomy, in order to render more complete the action induced by the operation according to these different methods. It should also be noted that extrapleural plombage may sometimes be employed with some measure of success in order to arrest and control obstinate and recurring cases of hæmorrhage from a cavity. The exact position of the cavity is first localized as far as possible by X-ray examination, preferably stereoscopic, and the procedure as described above is then performed over the area where the cavity is supposed to exist.

The Conduct of Thoracoplasty.

It was a Swiss physician, De Cerenville, who was the first to conceive the idea of the resection of ribs as a means of dealing with cases of pulmonary tuberculosis. Extrapleural thoracoplasty was originated by Brauer and Friedrich, who realized the importance of placing the diseased lung at rest; they conceived the possibility of accomplishing this by reducing its volume by means of a resection more or less complete of the bony thorax on the diseased side. These extensive operations, however, have led to a terrible mortality generally, owing to shock, to sudden displacement of the mediastinum and heart, and to the suturing of the great vessels, all of which structures after the operations of Brauer and Friedrich are no longer supported by the bony framework. At each inspiration they are drawn to the opposite side of the chest. These serious interferences of function may be already observed during the operation itself, and one can well understand the possibility of a fatal issue if the heart is already attacked and enfeebled by a long and serious illness, such as active and progressive pulmonary tuberculosis. The gravity of the operation of Brauer and Friedrich has led surgeons to try and discover another method less severe, less likely to be fatal, and more certain as to beneficial results. Wilms, developing the ideas of Quincke, Bier, Landerer, Turban, Mickulicz, and others, has resorted to a limited paravertebral resection of the first eight ribs. This operation can be well supported by the patient as a rule, but the results are often insufficient. Like "plombage," this limited resection as carried out by Wilms does not fulfil the essential condition of collapse-therapy; that is to say, it does not lead to a collapse which will involve the whole of the lung, and so affect every possible diseased portion, including the parts which cannot be observed clinically. The minute tuberculous lesions already present in lung substance apparently healthy have a tendency to spread rapidly and

become aggravated after an intervention which is too limited. It is as a result of these observations and following on these considerations that Sauerbruch invented the method of paravertebral costal resection, involving the whole height of the thorax, but much more limited as regards breadth than the operation of Bauer-Friedrich. It is Sauerbruch's operation which is now usually meant when the term extrapleural thoracoplasty is used, and it is this method which is generally employed at the present time. This operation is certainly one which is capable of producing mechanically and physiologically a retraction of the whole lung, thus maintaining local rest of the unsound tissues and favouring transformation into fibrous tissue. It is a procedure which is much less dangerous than the more extensive operations, and one in which the ultimate results are frequently excellent and durable.

The Technique of Extrapleural Thoracoplasty.

The technique of extrapleural thoracoplasty is now well established, thanks to Sauerbruch. The method of anæsthesia is important, and has a considerable bearing as regards the ease of performance and the severity of the operation. Some surgeons employ a general anæsthetic, but where such is used there is danger of aspiration of secretions from the bronchi and cavities, and of dissemination of tubercle bacilli from the upper lobe into the lower part, and especially into parts of the healthy lung. This danger is greater if the patient has a large quantity of secretion and does not expectorate sufficiently. It is certainly better, however, to use a good general anæsthetic than a bad local one, which still allows of much pain. In this latter case there may be provoked inhibition of respiration, dilatation of the right side of the heart, and reflex movement of inspiration, which may cause aspiration of the contents of bronchi and cavities into uninvolved lung tissue. By far the best procedure is that of paravertebral anæsthesia by novocain. Into each nerve root on the side to be operated upon there is injected 5 to 6 centimetres of 1 per cent. solution of novocain to which has been added 1 milligramme of adrenalin for each gramme of novocain. The line of the incision is then infiltrated with a 0·5 per cent. solution of novocain to which adrenalin has also been added. By this procedure it is possible to obtain an excellent anæsthesia employing not more than a gramme of novocain altogether. For some days before the operation the patient should have a course of cardiac tonics; an hour before the operation he should be encouraged to expectorate as much as possible so as to empty cavities and bronchial tubes, and there should then be injected under the skin 1 centigramme of morphia and $\frac{3}{10}$ milligramme of scopolamine, in order, if possible, to diminish sensitiveness to pain, and to act generally as a

sedative. The injection of the skin and local anæsthesia having been satisfactorily produced, the patient is placed in a half-sitting position lying on the healthy side and with the arm of the diseased side raised towards his head by an assistant. The operation itself can be performed in one stage—that is to say, in a single operation resection can be carried out of the first eleven ribs, the twelfth rib being unimportant. If from any cause whatever this is thought to be too severe a measure and likely to cause too much shock, the number of ribs resected may be limited, and the operation completed at a second stage about three weeks later. The removal of the first and second ribs is the most difficult part of this operation and one which takes the longest time to carry out. That is why the operator generally leaves the resection of the first two ribs for the second stage. Whether the operation is performed in one or two parts it is always necessary to resect the first ten or eleven ribs. The operation should always be commenced from below, in order that the inferior parts of the lung may be the first collapsed, so as to prevent if possible the flowing or the aspiration of septic secretions into the field of the operation. Another important point is that the costal segment should be taken away right up to the vertical column, in order to promote the general retraction of the hemithorax, and to prevent the development of pain which would probably result if portions of the ribs in this situation were left behind projecting under the skin. The resection of the first rib is absolutely necessary, to allow of the retraction of the thoracic wall. The resection of the eleventh rib has the immense advantage of allowing afterwards a considerable ascent of the diaphragm. The periosteum should be resected with the ribs if it is thickened or adherent to the pleuræ or to the rib, for an irritated periosteum will produce bony points which are capable of immobilizing the thorax in the position of inspiration, and thus of annihilating in great part the result of the operation. It is an important thing to resect, for the length of 1 or 2 centimetres, the exposed intercostal nerves, so as to prevent the troublesome neuralgic pains which may otherwise subsequently torment the patient. The anæsthesia which results, and which involves at once the thoracic wall and the upper part of the abdomen, disappears after a few months, the growth of nerve fibres in the neighbourhood establishing compensation.

The length of the incision should be proportional to the number of ribs to be resected. In the typical operation performed in one stage, the incision should be commenced at the level of the fifth spine, three fingers' breadth outside the vertebral column; it is then continued downwards parallel to the vertebral column as far as the ninth rib, whence it is carried forward below the costal arch towards the mid-axillary line. The incision should divide by one sweep of the knife all tissues down to the ribs; the edges of the incision are widely retracted

and all bleeding points stopped. There then follows the resection of the tenth rib, and then ribs ninth to fifth. The eleventh is dealt with in its turn. The wound is well swabbed and plugged with gauze, and the incision is finally extended upwards to the neck. This manner of performing the incision in two phases has the advantage of minimizing the loss of blood, and of lessening the reflex and the shock produced by the sudden division of a large extent of tissue. The resection of the ribs is continued from below upwards, and usually offers no particular difficulty until the first rib is reached, except that the internal border of the scapula becomes freed from its attachment and so tends to project from the thorax. The second rib having been resected, the incision is then prolonged as far as the anterior border of the trapezius muscle. Branches of the superior cervical and tranversalis colli arteries bleed, and have to be caught by forceps. It is necessary then to retract strongly the superior angle of the wound, in order to procure a clear view of the first rib with the insertion of the scalenus anticus muscle, the subclavian artery, and the brachial plexus, with a special instrument by means of which one is easily able to surround the bone.

About 3 centimetres of the rib are removed, and the vertebral fragment is shortened as far as possible afterwards. The operation is now finished. It is necessary, however, to shorten as far as possible the vertebral fragments of the ribs by separating the soft parts and drawing them inwards. The intercostal nerve should also be resected for the length of 1 or 2 centimetres and eventually the periosteum; all bleeding should then be stopped and the soft parts sutured. The suturing should be done with catgut and in two layers for the superior part of the incision where the tissues are thick, and in a single layer for the inferior part. A drain with several openings is placed beneath the muscles along the whole length of the wound, opening out at the inferior angle; the skin is then sutured. A thick aseptic dressing, compressive and elastic, should be applied in a manner to aid the retraction of the hemithorax. For this purpose also three bands of strapping are applied at some centimetres distance to maintain the first pieces of dressing, and a bandage of elastic tissue such as crêpe is also applied spirally from the healthy shoulder to the abdomen, so supporting the lower layers of dressing. The length to be resected in the case of each rib depends upon the anatomico-pathological conditions directly underneath. A length of each rib, 6, 12, 15 centimetres, or even more, should be taken away at the level of the diseased lobe, whilst at the level of the healthy parts of the lung a much less extensive amount need be removed. It is important never to neglect in a complete thoracoplasty the resection of the tenth and eleventh ribs, for at this level the operation produces the very important result of suppressing the tension of the diaphragm necessary to its function, and of aiding to

the maximum the depression of the inferior part of the thorax. After this suppression has been effected, the diaphragm rises into the thorax even in inspiration, no longer being supported by the ribs, and it is therefore only to a very limited extent able to perform the respiratory movements.

Indications for a Thoracoplastic Operation.

Generally speaking, and assuming that the opposite lung is practically healthy, that the heart and other vital organs are sufficiently good, thoracoplasty is indicated whenever artificial pneumothorax is insufficient or impossible owing to adhesions. If the whole lung is adherent pneumothorax is impossible. If one lobe is adherent to the chest-wall, and if the pneumothorax, which can be only partial in this case, does not produce a sufficient collapse of the diseased lobe, or if the pneumothorax is a dangerous procedure because an efficient pressure would be likely to produce the rupture of the adhesions and so risk the formation of a pyo-pneumothorax, then thoracoplasty is certainly indicated either as an operation in itself, or in combination with a partial pneumothorax or with a plombage. These are our guides deciding action in a case of pulmonary tuberculosis. Thoracoplasty may also be used in connection with a pneumothorax which has been prolonged for a sufficient time, and when, for example, an attempt at decompression is followed by bad results, or when the economic situation of the patient does not allow of the possibility of frequent insufflation necessary to the upkeep of the pneumothorax. In this latter case, and especially among the poor and working classes, much time may be gained by giving up the production of a pneumothorax in favour of thoracoplasty. In the great majority of pneumothorax cases innumerable insufflations extending over periods of long duration, perhaps for years, are to be considered necessary before it is safe to count the patient as free from danger of relapse. There are some patients, in fact, who have to go on with refillings all their life. The operation of thoracoplasty does away with these troublesome and expensive refillings, and much more quickly renders the patient independent of the doctor; but like every operation which diminishes the size of the thoracic cage, it presents certain dangers connected with the lung on the opposite side, with the heart, and with certain foci which may exist in other organs—tuberculous foci apparently inactive or unknown. It is in this manner that one can see, after thoracoplasty in a badly chosen case, the opposite lung showing, about six weeks after the operation, changes in the rate of respiration, presence of râles, and finally development of excavation. The temperature in such cases, instead of coming down, remains high or even goes higher. The general condition is steadily downhill, and a fatal issue usually quickly

supervenes. Sometimes a caseous tuberculous pneumonia develops. In other cases it may be that an ordinary pneumonia or a broncho-pneumonia is produced, and this tends rapidly to get well. Then again, the fact that certain tubercular foci situated in other organs may show, after the operation, signs of activity indicates that the collapse of the lung which is produced by this operation sets free into the circulation a considerable dose of tuberculin, or of bacillary products which have a distinct influence on the course of the case. But it may happen, as indeed has been seen in cases treated by tuberculin, that these reactions are too intense, the general state becomes one of grave toxæmia, and death quickly follows. Nevertheless, it is frequently observed that, after a thoracoplasty, foci present in the opposite lung show an astonishing tendency towards improvement. The condition of the heart has also to be considered. Organic lesions and muscular feebleness of the heart and degenerative changes in the myocardium are all to be considered contra-indications for operative interference. Every person who is cyanosed, without the presence of a lesion being found on auscultation of the heart and investigation of the great vessels, and even if he has a normal cardiac action, is in danger of post-operative myocardial insufficiency. Any serious affection of the viscera or other organs, whether tuberculous or not, affecting the general health, is also a reason for rejecting a patient for operation. Finally, let us emphasize the statement that, when considering the indications or the contra-indications to operation, there should be a minute and prolonged observation of the general and local condition, and collaboration between physician and surgeon.

Finally, we may summarize as follows: The principal indications for performing thoracoplasty, assuming that the opposite lung is healthy, are: (1) Insufficient effect produced by artificial pneumothorax. (2) The impossibility of inducing an artificial pneumothorax, either because of too many adhesions, or because of the risk of tearing adhesions and thus producing a pyo-pneumothorax. (3) The economical situation of the patient preventing the following out of the long, tedious, continuation treatment after pneumothorax. (4) Repeated hæmoptysis. (5) Chronic tuberculosis, empyema and chronic pyo-pneumothorax which do not yield to ordinary medical treatment—that is to say, removal of fluid and replacement with air. (6) Tuberculous empyema, or pyo-pneumothorax with a cutaneous fistula. (7) Acute pyo-pneumothorax in cases where the patient has got over the initial shock and is preserving a sufficient state of general health. (8) Thoracoplasty might also be employed in those rare cases where the sclerosis of the diseased lung has caused a kink in the trachea, thereby leading to mechanical dyspnœa.

Let us enumerate the conditions which are to be counted as favour-

able to thoracoplasty: Good general health. A unilateral affection even if involving the whole of the lung. Spontaneous tendency to the formation of fibrous tissue and to retraction of the lung. A fair amount of elasticity of the fibrous shells which surround the cavities.

The contra-indications to the operation are as follows: Bad general condition, existence of acute tuberculosis, even when unilateral; advanced tuberculosis of the intestines or the larynx. Tuberculosis of the other organs, especially if multiple or acute. All serious disease (not tuberculosis) of other organs. High fever which is due simply to activity in the diseased lung is not a contra-indication, neither is tuberculosis of the opposite lung, or in other parts if inactive for a long time. Small obsolescent foci in the opposite apex are not a contra-indication to the operation, but it is no longer the same if these foci, even if minute, are situated at the hilus or in the lower lobe. One does not operate upon children, in whom the thoracic wall is very supple, and as regards patients after the age of fifty, if the operation is to be thought of, care should be taken to ascertain that the heart and great vessels are in a good state of preservation.

What can be said as to post-operative conduct and results? The operation always produces a certain amount of shock, especially if performed under a general anæsthetic. However, it is amazing to see how extraordinarily well it is tolerated as a rule, even by enfeebled individuals, especially if performed with prudence and discretion and according to requirements. There is nothing to prevent, if necessary, the procedure being carried out in two or even three stages, at intervals of three or four weeks. During the first days after the operation cough and respiration are extremely painful. It is impossible to do without the use of morphia, and if by chance a patient is not able to tolerate this drug the situation can be very unpleasant. It would be even better, if this lack of tolerance to morphia be known, to refuse to do the operation. In order to help the cough and expectoration, the nurse should be instructed to compress the part operated upon immediately the desire to cough is felt by the patient, for there is always the danger of aspiration during the first few days. If the cough is greatly hindered by pain, there must follow naturally a sharp, sudden reflex inspiration, which is capable of drawing into the healthy lung the septic contents of bronchial tubes or cavities from the operated side. As soon as possible, the patient is placed in a half-sitting position, and the nursing staff should be instructed to leave the healthy side as free as possible, so as to facilitate respiration. Inhalations of oxygen will not as a rule be necessary.

In all cases submitted to thoracoplasty it is very important to take care of the digestive functions, for constipation and flatulence form a considerable mechanical hindrance to respiration, and may help to

produce a congestive condition of the thoracic organs. There is generally some fever after the operation, lasting four or five days. This results either from absorption from the large operation wound, or from inflammatory reaction occurring in the compressed lung, or from products of the tuberculous lesions being absorbed into the circulation. The temperature afterwards descends little by little, and generally becomes normal in three or four weeks' time. If the fever persists for a longer period, then this is to be taken as a bad sign and means that a fatal complication is developing, oftentimes situated in the other lung. The sputum at first is increased; it is squeezed out of the lung, and is also produced in larger quantities owing to the interference with this organ. It then diminishes in a most striking manner. From several hundreds of grammes a day it may be reduced in a few weeks to a very small quantity. The other unpleasant symptoms, such as pain and fatigue, cough, danger of aspiration, etc., diminish rapidly. The reduction of the amount of expectoration is a very favourable sign, especially as regards the prognosis. If, having diminished, the expectoration again becomes increased, it is probable that new foci are in activity. However, if the operation is performed in several stages, one may see a temporary augmentation of the sputum after each phase of the operation, until the total procedure has been completed. As well as becoming less in quantity, the sputum becomes more liquid and less purulent; the bacilli diminish rapidly in numbers and frequently disappear altogether. Finally there may persist merely a very small quantity of expectoration, perhaps 10 to 20 cubic centimetres a day, which is free from tubercle bacilli. This is produced by the catarrhal secretions of bronchial tubes and cavities, which have not been completely obliterated. At the same time as these phenomena are noted the general condition of health improves rapidly; the appetite returns, the weight increases, and the whole appearance of the patient undergoes marked betterment. If this general improvement in the appearance is wanting, a complication must be feared, and this generally happens in the supposed healthy lung. The cavities retract rapidly after thoracoplasty, but sometimes they require a certain period for the collapse; it may be that their situation is in the centre of the lung, which protects them to a considerable extent from the post-operative retraction, or it may be that the fibrous capsule of the cavities is too hard and resistant. However, the process of sclerosis continues for a long time after the operation, and cavities which have not diminished in volume at the end of two or three months may show themselves completely flattened after ten or twelve months. It should not be necessary then to have recourse to a further operation, such as plombage, or another resection, or a phrenecotomy. Sauerbruch waits at least six months before deciding

whether or not a further operative interference is necessary. Thoracoplasty, of course, is not successful in every case. The patient has to be carefully watched and treated to give the best results, and it may be necessary after several months, or even after several years, to resort to a supplementary operation. On examining a case of thoracoplasty, it will be seen that there is a great extent of lateral depression of the thoracic wall below the scapula. The side which is the seat of the operation hardly moves at all during respiration, the healthy side taking on all the work. The respiration and the action of the heart as a rule remain normal, but sometimes dyspnœa is very easily produced on exertion. The lessening of the pulmonary circulatory system is not without its action on the heart, and results in a certain amount of hypertrophy of the right ventricle. Compensation for this, however, is easily produced. The heart is pushed over to the right after a left-sided thoracoplasty, and to the left after a right-sided one. Its movements are easily palpable, and are felt almost like a rubbing; the lung presents a typical picture. On the side which is the seat of operation the lower lobe presents complete dullness. The upper lobe is, on the contrary, tympanitic, because of the presence of the trachea and the large bronchi. If cavities remain patent they are tympanitic, and give the modified note of Wintrich. The healthy lung will be seen to have become hypertrophied, there is a compensatory emphysema, and the limits of the healthy lung have become broader and can even extend over the diseased side. After a left-sided thoracoplasty the right lung has been observed to cover the heart, and hinder it from being examined in the usual way.

Auscultation of the side which has been operated on gives unexpected and quite non-classical results. At the apex the respiration is of the bronchial or amphoric type; the vesicular murmur is lessened, and is rather harsh; expiration is prolonged. As one descends the respiration diminishes, and in the lower part of the lung it is absent; inspiration is harsh and of the cogwheel type; expiration is feeble, prolonged, and sometimes not to be heard. Towards the hilus, breathing is of the bronchial type; along the length of the vertebral column, one is able to hear the emphysematous breathing of the opposite side. Râles of all kinds can be heard throughout the lung on the diseased side. Fine crepitations, gross râles, musical and tinkling râles, may be heard, especially in the upper lobe, but not to anything like the same extent at the base; they tend to change on coughing. These sounds are practically always heard, even in cases where the operation has been a complete success. They are present without any expectoration or other catarrhal manifestation. They tend to get less as the years go by. Broncophony and pectoriloquy are as a rule only heard over cavities which have not yet collapsed. The respiration on the healthy

side is that of compensatory emphysema; it is rather harsh and increased in intensity; it transmits quite plainly all the noises of the diseased lung, a fact which must not be lost sight of when one is trying to form an opinion of the state of the supposed healthy side. From these facts one is forced to the same conclusions as Sauerbruch—that is to say, that one cannot judge adequately of the result of a thoracoplasty from percussion and auscultations alone; even several years after the clinical "cure," abnormal breathing and râles are often to be heard in the operated side.

The general result of the extrapleural thoracoplasty in well-chosen cases appears to be most encouraging. Physicians and surgeons who have had sufficient experience of this surgical procedure invariably favour the method. Without doubt in a disease so insidious, so much to be feared, and so tenacious, as is pulmonary tuberculosis, one must naturally expect a certain number of failures; but, on the other hand, there is already to be put to the credit side of thoracoplasty, a large number of successes lasting at any rate from six to twelve years, and it must be remembered that these successes are all in cases which were definitely going to the bad, and in which all the other means of treatment had failed. The operation alone must not be considered sufficient in itself; it must be followed by the ordinary régime—fresh air, climate, sanatorium treatment, etc.—of a phthisical patient. Advantage must be taken of the benefits obtained from the operation. The resistance of the organism must be raised as high as possible, as should be the case in every person who has become a victim to Koch's tubercle bacillus.

Statistical Considerations.

Archibald of Montreal, in 35 patients in whom the operation was performed in two stages, records 3 post-operative deaths—(1) cardiac failure on the twelfth day; (2) effects of suppuration on the twenty-first day; (3) acute tuberculosis of the opposite lung in the seventh week—besides, in 5 other cases death supervened owing to cardiac failure twice, and owing to acute bronchitis three times. Nine patients died later on, from two months to three years after the operation; in 6 of these death was caused by an acute spread of tubercle in the other lung. One died of hæmorrhage, another of pyo-pneumothorax, and another of typhoid fever. In one year after the operation 5 patients were practically cured, 5 very much better, 5 certainly improved, and 1 *in statu quo*. Guilleminet, in a thesis from Lyons, discussing 27 cases dated from ten years' duration to some months, notes 9 very good results, 5 fairly good and improving, 3 incomplete results, 1 *in statu quo*, 3 post-operative deaths, and 1 death from secondary causes. Sauerbruch, in 507 thoracoplasties, performed by himself, records 33 per cent. of "cures," a

certain number of which are of six years' or more duration, besides which he mentions 27 per cent. in which there has been great improvement. Brauer mentions 30 per cent. of "cures" and about the same number in whom improvement has occurred. Burnand of Leysin, in 7 cases operated on by Professor Roux of Lausanne, notices 6 cases in which the result has been extremely good. He considers 3 of them as cured after three months. This period of time, however, is in our opinion too short upon which to base any definite conclusion. Bull of Christiania in 75 cases mentions 8 post-operative deaths; in 35 tubercle bacilli disappeared from the sputum after the operation, and in 22 of this latter class 15 could be considered as cured ten months to eight years after the operation, whilst in 27 cases in which bacilli remained there were found in the same period of time 15 deaths, 10 in which the disease was spreading; and there were also 2 apparent cures. Berard of Lyons in 23 cases reports 4 post-operative deaths from general tuberculosis. Jacobeus and Key have published a series of 55 total thoracoplasties and 5 partial. They have had 5 post-operative deaths, and 16 deaths later, of which 11 were from tuberculosis, 5 negative results, 15 apparent cures, and 19 in which there was great improvement. Sixteen of these cures and improvements have lasted from four to six years.

The Conduct of Phrenecotomy.

The physiological suppression of the phrenic nerve brings about paralysis of the diaphragm. This muscle no longer takes its share in the mechanism of respiration. At every inspiration, instead of becoming stretched and supplying a rigid base for the elevation and expansion of the ribs, it rises into the thorax, drawn there by the negative pressure. The respiratory activity of the corresponding lung is lessened, especially in the lower lobe, the movements of which become eventually very much reduced, and the lobe itself undergoes a certain degree of permanent contraction. Either the simple section or resection of a certain length of the phrenic nerve brings about much the same result, but after simple section the nerve is likely to regenerate again pretty quickly, and thus nullify the effect and benefit of the intervention. This is the reason why Felix has introduced a mode of resection of the phrenic nerve by tearing, going as low as possible in order to destroy with certainty the motor branches which supply the diaphragm, and especially the accessory phrenic nerve, which is present in about 20 per cent. of cases. The paralysis of the diaphragm then becomes permanent, and the more complete it is, the higher does the diaphragm rise into the thorax. As a result of the exclusion of the function of the phrenic nerve, the same phenomena of sclerosis are seen to develop as

is the case after an artificial pneumothorax or a thoracoplasty, but naturally to a much less considerable extent. This last observation leads us to expect immediately that the rôle of phrenecotomy can only be used as an accessory in the therapeutics of pulmonary tuberculosis. The technique is simple. The nerve arises from the fourth cervical segment, and receives accessory fibres from the third, fifth, and sixth cervical nerves, and also sympathetic fibres from the inferior cervical ganglion. The trunk of the nerve can be easily got at, on the anterior surface of the scalenus anticus muscle.

A local anæsthetic is amply sufficient for carrying out the operation of phrenecotomy. The patient is placed in a semi-recumbent position, the head leaning rather backwards, and the face turned towards the side opposite to the field of operation. At the posterior border of the sterno-cleido-mastoid muscle a depression may be felt two fingers' breadth above the clavicle. In this neighbourhood the scalenus anticus muscle is only separated from the skin by a small layer of fat. The incision may be parallel to the posterior border of the sterno-cleido-mastoid, or transverse on the depression indicated above. After the division of the skin and platysma, the layer of adipose tissue must be incised with great care, and the transverse cervical artery tied. The anterior surface of the scalenus anticus muscle, on which lies the phrenic nerve, is then easily exposed. The nerve is isolated, and either simply cut or else resected for a length of 2 or 3 centimetres, by pulling upwards the inferior part, according as to whether a temporary result only, or a permanent suppression of the function of that side of the diaphragm, is required. This little operation may even be performed on patients who are in a very serious condition, and does not give rise to any immediate shock. It is usually followed by a temporary rise of temperature, but at the end of two or three days this comes down, in a unilateral case. If on the other hand the opposite lung contains active foci, the rise of temperature persists, fresh râles appear, the general state may become worse, and rapid softening or general tubercle may follow. This danger is, however, less considerable than after a thoracoplasty, especially if a simple section only has been performed. The operation, therefore, may be employed as a diagnostic method to test the susceptibility of the opposite lung, in cases where pneumothorax is impossible. From the therapeutic point of view, resection of the phrenic nerve produces an elevation of the diaphragm of more than 4 centimetres, the action of which not only makes itself felt at the base, but also, as can be shown by radioscopy (Alexander), in those parts which have the most tendency to spontaneous retraction—that is to say, in the diseased parts. The result of the operation in unilateral cases showing a tendency to sclerosis is often remarkable; the temperature falls, the expectoration becomes less, and the lung is

invaded by fibrous tissue; the general state improves, and the tubercle bacilli diminish or disappear altogether from the sputum.

The indications for the exclusion of the phrenic nerve have been laid down by Alexandra: (1) In severe unilateral cases, where, in spite of the tendency to produce fibrous tissue, the activity persists. (2) Before a thoracoplasty, whenever there is a doubt concerning the state of the supposed healthy lung, in cases where pneumothorax is impossible or dangerous (because of adhesions or cortical cavities, etc.). If the resection of the phrenic is in itself an insufficient measure, its action may be completed later on by a thoracoplasty, or in special cases by a plombage.

General Conclusions.

After perusing this short review concerning the surgical treatment of pulmonary tuberculosis, there will still occur to the reader, no doubt, many important points, especially as regards a summary of the most ordinary indications for operation. To solve this problem, there is necessary most careful observation of the patient, and a certain degree of clinical instinct, which can only be attained by experience. Collaboration between the physician and the surgeon is without doubt very necessary, but in the majority of cases the operator will be wise to accept the indications put before him by the patient's medical adviser and the tuberculosis specialist. However, the doctor and surgeon must have a more or less clear knowledge of the indications for surgical treatment with relation to pulmonary tuberculosis. That is one reason, and the most important reason, why this paper has been written, to attempt to put the whole matter in a concise form before the practising physician. The results obtained up to the present certainly are encouraging, and lead us to hope that there is a great future for this method of treatment. When doctors and the public are more accustomed to the idea of the operative treatment of phthisis, then will the knowledge of indications for operation become more clear and certain, and it will certainly be possible to operate more often at the right time, and in a larger number of cases. A considerable number of unfortunates will thus, we hope, be not only saved from death, but be able to resume an active life, and so regain in some measure the social and economic value of their existence.

HELIOTHERAPY AND ACTINOTHERAPY AT THE HERITAGE CRAFT SCHOOLS, CHAILEY.

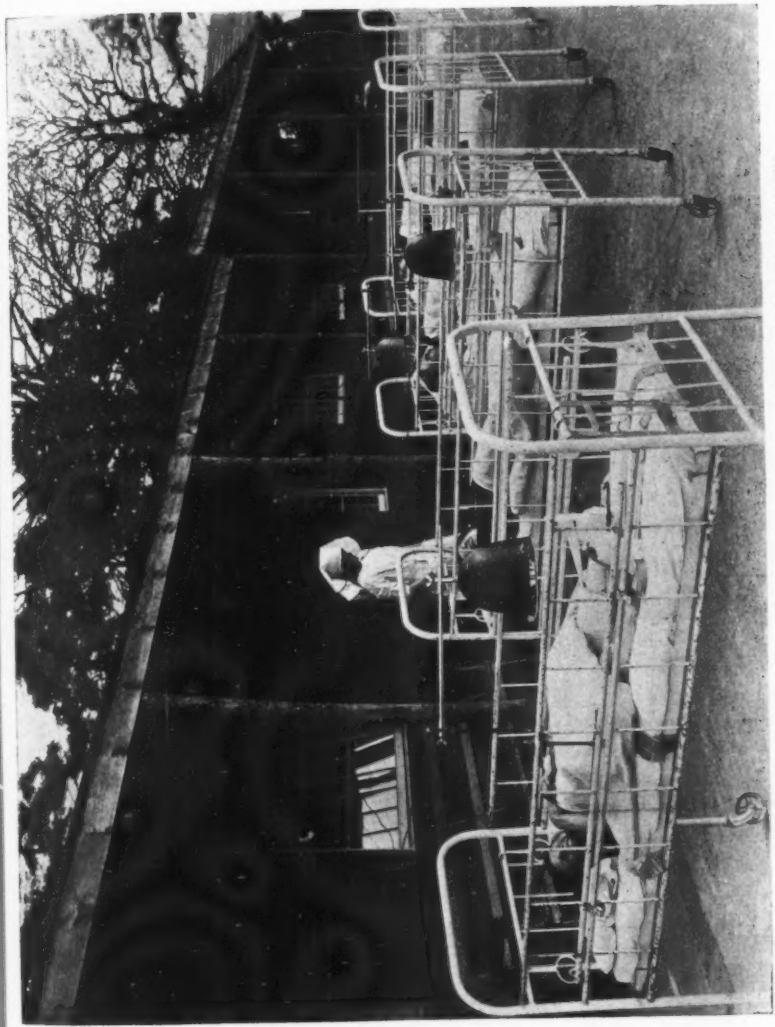
By GEORGE MURRAY LEVICK,

M.R.C.S., L.R.C.P.,

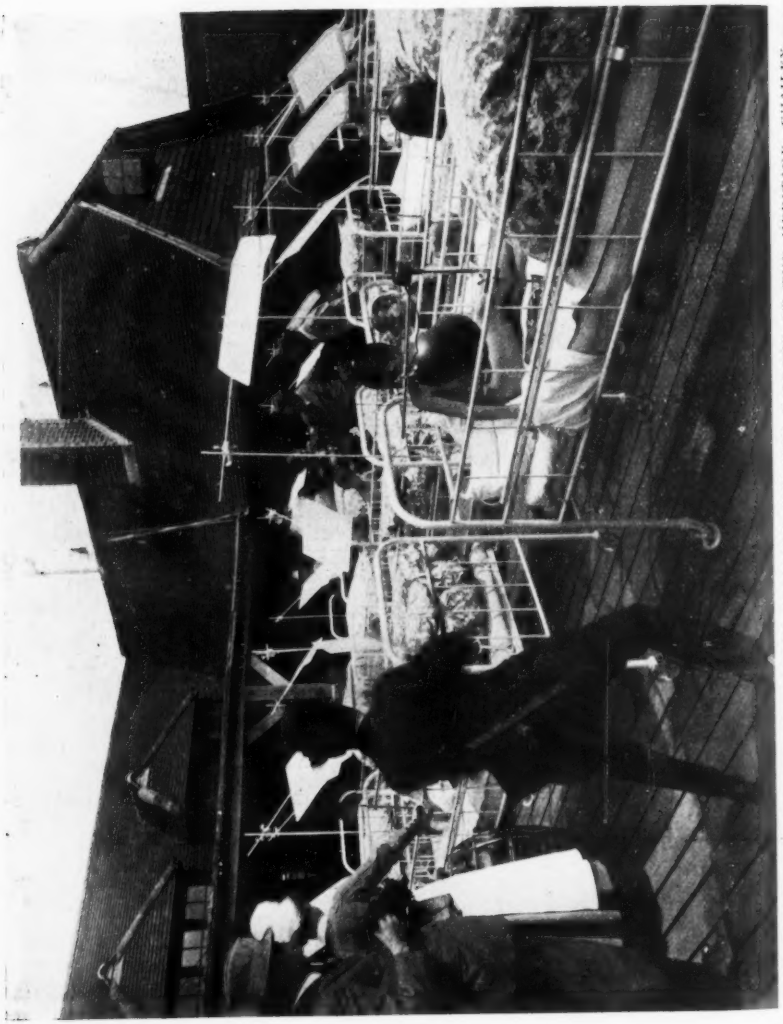
Medical Director to the Heritage Craft Schools, Chailey; Medical Officer, Electrical Department, St. Thomas's Hospital, London.

At the Heritage Craft Schools, Chailey, special provision is now made for the treatment of surgical tuberculosis in children by heliotherapy and actinotherapy. The purely surgical aspects are met by the inclusion of a first-class operating theatre and accessories, a first-class X-ray installation, plaster room, and other adjuncts. The services of Mr. S. L. Higgs, F.R.C.S., are available as honorary consultant orthopedic surgeon. The most imperative need of our tuberculous cases at Chailey is the production of an immunity from the tubercle bacillus. This we seek to secure in the following manner: The hospital ward of thirty beds opens on to a gallery facing south, and is capable of accommodating all the beds. The communicating door is so constructed that the beds can be easily wheeled in and out. This gallery is sheltered from the north, east, and west, and faces across the beautiful Sussex Weald on to the Downs, which are plainly visible in the distance. On this gallery the patients can be treated by real sunlight when this is available. For a considerable portion of the year the children are able to sleep in the open. The duration of sunshine during the year at Chailey is, I believe, as long as in any other part of England, but this is inadequate to provide continuous treatment excepting through the summer months in lucky seasons. We have therefore arranged that on the west side of the open-air gallery there is a door opening into a room fitted with an excellent installation for the application of artificial light treatment during sunless weather. Patients may have this treatment daily or every other day, or as their condition demands. It cannot be said that the results of this artificial treatment in any way fall short of those which result from exposure to the real sunlight.

The apparatus for actinotherapy used at Chailey consists of a combination of a mercury vapour lamp and long rays from a lamp of my own designing. This combination of lamps I have found to be superior from every point of view to the customary carbon arc lamps, not the least of the advantages being that the proportion of heat rays can be so easily regulated according to the temperature of the air and the particular needs of the patient. The treatment of open tuberculous lesions is carried out in an original manner by means of a lamp that I have specially designed for the purpose. Each lamp consists of a



DR. MURRAY LEVICK'S BABY LAMPS IN USE AT THE HERITAGE, CHAILEY.



DR. ARKETTE EQUIPS OF LEYSIN VISITING THE SON, ESTEEMY AT THE HERITAGE, CHAILEY.

metal rod carrying an incandescent lamp, backed by a suitable nickel reflector, and can be clamped to any part of the side of the cot. The reflector projects the rays from the lamp, so that they can be directed upon and around the surface of any local lesion. A wound can be treated in the open air, and yet in cold weather can be kept warm by the heat rays from the lamp. I am now quite convinced of the value of the visible rays in increasing the power of resistance and repair in the tissues, but whatever may be the actual factor in regard to this, there is no question as to the startling results which are achieved by this form of treatment. While it is in progress no dressings are necessary, the wound being left open to the air. When the treatment is first started, most indolent ulcers, sinuses, etc., exhibit a profuse discharge of exudates, quickly followed by increased tendency to heal. When a sinus is discharging profusely it is well to have a bowl of swabs handy, so that the wound can be swabbed at intervals. Apart from the beneficial effect of the light and air upon the raw surfaces, there is a great advantage in being able to discard dressings for long periods, and thus give relief to the tissues of the part from the pressure of bandages. I strongly advise the inclusion of such a lamp as we are using at Chailey in the equipment of all hospitals, and particularly for the treatment of surgical tuberculosis. The accompanying illustration shows how these lamps can be attached to the cots. One is being employed in the treatment of tuberculous cervical glands, one for the healing of a tuberculous ulcer of the ankle, and the other is radiating a patient suffering from synovitis of the knee-joint. In summer-time it will be found necessary to cover the lamp and the part under treatment with a small mosquito net to prevent the access of flies.

Ulcers and sinuses have been very successfully treated by actinotherapy at Chailey. As a simple example of the effect of the rays from these lamps I will mention a case that was recently under our care. A boy suffering from a tuberculous joint suddenly exhibited an abscess in the subcutaneous fascia on the inner aspect of the upper arm. When I first saw it, it was fluctuating, the skin over the local lesion was bulging, was red and beginning to glaze, and, in short, it was an abscess just beginning to "point" through the skin. Instead of aspirating it, I ordered treatment by the "Baby Lamp," the nickname given to our lamp. The dosage was one hour in the morning and one hour in the evening. At the end of a week the whole of the fluid was absorbed, and there was only a patch of induration the size of a half-penny under the deep surface of the skin. Treatment was continued for one more week, and at the end of that time the induration had completely disappeared, leaving the skin and subcutaneous fascia soft and elastic, there being nothing but a slight stain left to mark the spot where the abscess had been.

HYGIENIC AND ECONOMIC FACTORS IN THE INCIDENCE OF TUBERCULOSIS AMONGST SCHOOL-CHILDREN.

By AUSTIN PRIESTMAN,
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Assistant Medical Officer of Health and School Medical Officer to the Borough of Folkestone.

The accompanying table indicates the various elementary schools in Folkestone, their locality, the type of child in attendance, the number of children referred, during the years 1922 and 1923, to the tuberculosis dispensary, the number of these subsequently notified as suffering from tuberculosis of the lungs, and the number of children suffering from lung conditions clinically resembling tuberculosis or definitely pre-tuberculous.

As to family and personal history the following points are of interest:

(*a*) *Tuberculosis* was recorded as follows:

Amongst the 17 children notified in *1922* ... 5 cases.
" " 42 doubtful ... ... 3 "

Among two of the "doubtful" cases there was a history of weak chest in one of the parents, and in another of the "doubtful" cases a brother attending the tuberculosis dispensary.

(*b*) *Bronchitis or Asthma:*

Amongst the notified children ... ... 0 cases.
" " doubtful ... ... 4 "

Of important contributing causes the following may be mentioned: (1) Malnutrition at birth; (2) poor nutrition from early childhood onwards; (3) the acquirement of measles or whooping-cough, or both, in early life—*i.e.*, under the age of three years.

There is considerable evidence available to support the belief of Sir Robert Philip and others that much of the so-called bronchitis, and perhaps asthma, of childhood are merely names for tuberculous processes of a more or less chronic type, and calling for similar care and treatment to that given to other forms of tuberculosis.

The schools with the highest number of notifications are in the following order: (A), (D), and (C). The explanation of the high position of (D) is that, although the bulk of children are recruited from the better labouring-class, the school is also supplied by some living in the bad overcrowded homes supplying (A). (K) illustrates well the small relative importance of the school factor compared with the home or housing factor.

TABLE OF ANALYSIS OF CHILDREN EXAMINED AT THE FOLKESTONE TUBERCULOSIS DISPENSARY.

The expression "Hygienic Factor" (H.F.) is intended to represent a broad survey of various items, such as ventilation, lighting, cleanliness, etc.

School and Average Number on Books.	Situation of School. Hygienic Factor (H.F.): (1) Good; (2) Poor: (3) Very Poor.	Home and Housing Conditions.	Number sent to Dispensary; Subsequently Notified.	With Signs Suggestive of Tuberculosis or Pre-Tuberculosis.
A. 753	High *plus* open surroundings. H.F. (2).	Very bad. Poverty. Neglect. Labouring class.	1922 7 1923 2	4 14
B. 685	Over-enclosed. H.F. (2).	Good lower middle class.	1922 0 1923 1	7 11
C. 678	Over-enclosed. H.F. (3).	Labouring class and few fisherfolk.	1922 2 1923 9	3 8
D. 621	Over-enclosed. H.F. (2).	Better labouring class (mechanics, etc.).	1922 5 1923 5	11 12
E. 426	Good open surroundings. H.F. (1).	Good lower middle class.	1922 0 1923 0	8 1
F. 283	High; exposed near and above sea. H.F. (2).	Very poor. More air and less smoke than in case of "A." Children play much in harbour.	1922 1 1923 3	2 3
G. 210	Fairly good; rather enclosed. H.F. (1).	Widely varying. Small shopkeepers, fisherfolk, hawkers.	1922 1 1923 1	1 2
H. 181	Over-enclosed. H.F. (3).	Good. Lower middle class.	1922 0 1923 1	3 4
I. 156	Low; over enclosed. H.F. (2).	Fairly good. Small shopkeepers, better working class.	1922 1 1923 0	1 1
J. 152	Fairly open, but rather low. H.F. (2).	Fairly good. Motor mechanics, coastguard officials, small shopkeepers.	1922 0 1923 0	2 6
K. 68	Very over-enclosed. H.F. (3).	Widely varying. Vagrant up to good lower middle class.	1922 0 1923 0	0 0

I venture to think the following conclusions can be arrived at from a study of the table:

(1) The incidence of tuberculosis bears a direct ratio to the following: Overcrowding, density of population, bad home conditions and poverty, and in a much lesser degree to school conditions such as want of cleanliness, ventilation, lighting, and hygiene generally.

(2) The reverse holds equally good, that tuberculosis diminishes in direct and vivid proportion to the amount of sunlight, free circulation of air, good food and home conditions, and cleanliness.

(3) The bad effects of parental over-anxiety, and the delicacy caused in children by over-clothing and coddling (*vide* School E), and the necessity of the provision of sanatoria and open-air schools for the tuberculous and pre-tuberculous respectively.

(4) From my past experience and from what I continue to see, I am convinced that many of the numbers in the last column in the table will sooner or later be transferred to the preceding column, and swell the list of actual notifications.

(5) The table bears further proof of the righteousness and urgency of the lamentation of medical officers of health, which says "all efforts made by the medical profession to alleviate and abolish the incidence of tuberculosis and other diseases, some of which, especially measles and whooping-cough, act either as predisposing agents or as wind for a smouldering fire," are frustrated by economic and housing considerations.

I think this short communication will indicate in some measure that much valuable research work might be carried out by members of the school medical service if they were allowed more time and scope for such work. The intimate link between school medical work and the service of public health departments should be strengthened.

ASSOCIATIONS AND INSTITUTIONS.

THE MUNDESLEY SANATORIUM, NORFOLK.

THIS sanatorium, one of the earliest and best known of private institutions in England for the treatment of tuberculous patients, is situated 100 feet above sea level, in one of the driest, sunniest, and most charming districts in Norfolk. The soil is sandy, and the building faces south-south-west, situated near the foot of a pine-clad hill. The sanatorium consists of a main block, the brick block, a bungalow, nurses' home, doctors' house, and some detached châlets. There are also

GENERAL VIEW OF THE MUNDESLEY SANATORIUM.

numerous shelters in the grounds, which cover some 30 acres. All rooms occupied by patients face south, are lit by electricity, and wireless equipment is provided in many rooms. The main building, which was opened in 1899, has accommodation for twenty-six patients, each room measuring about 16 feet by 11 feet. The brick block presents several special features: windows which can be made to sink altogether out of sight, or can be manipulated to allow of the entry of varying amounts of fresh air; hot and cold water supply to each room; and central heating by radiators. The sanatorium is equipped with X-ray department, solaria, arc lamp for actinotherapy, and all necessary forms of modern treatment. Artificial pneumothorax and other surgical measures can be carried out in suitable cases. The resident medical staff consists of Dr. S. Vere Pearson, Dr. Geoffrey Lucas, and Dr. L. Whittaker Sharp; there is also a full staff of nurses. Special attention is devoted to diet, supervision of exercise, work, and recreation, and the provision of suitable amusements. There is an excellent library. Mundesley is easily reached from London by means of the Cromer Express Service.

NOTICES OF BOOKS.

TUBERCULIN TESTS IN CATTLE.

"UNTIL the day when some method of successfully immunizing cattle against tuberculosis is discovered, the recognition of a trusty and simple test by which the presence of a tuberculous animal in a herd may be speedily detected is greatly to be desired in the interests of the consumer of milk, of the cattle owner, and of the public health." These words, in the very carefully compiled and recently published report of the Tuberculin Committee, functioning under the Medical Research Council,[1] disclose the chief aim of the Committee's work, and form the keynote for those scientific measures which are necessary for the control and suppression of a disease, disastrous alike to the human and the lower animal world. To both the medical and veterinary professions, the report is of profound practical value, and its issue at a time when tuberculosis is engaging so much of public attention is most welcome and opportune. The report has special reference to the intradermal method of testing, and it is affirmed that this method, which is so clearly outlined by the Committee, "was the one most easily employed and at the same time gave the most consistent results regarding the presence or absence of tuberculosis in cattle." This conclusion was arrived at after a very careful study of the various methods of testing in vogue (subcutaneous, intradermal, ophthalmic), and after confirmation by pathological evidence—*i.e.*, by post-mortem examinations of reacting and non-reacting animals, associated with microscopical examination and injection experiments of laboratory animals. In the opinion of the Committee, "the subcutaneous tuberculin test is a perfectly satisfactory test for the presence of tuberculosis in cattle when carried out under the laboratory conditions of a scientific test, but it is not a satisfactory test when carried out under ordinary farm conditions: the discrepancies then prevailing are often so numerous as to vitiate the general application of the test for practical purposes." The intradermal method, on the other hand, was found to be accurate, the percentage of error being extremely small. It also carries further advantages over the subcutaneous method in that no temperature observations are required (these are laborious in the subcutaneous method, and temperatures of normal cows and young stock are very variable); that the animals need not be kept at rest before and during the test, but may carry out their ordinary farm routine; that fewer observations are usually necessary; and that a smaller quantity of tuberculin is required. The ophthalmic method is regarded of value as a subsidiary test, and it is used as such in conjunction with the intradermal test in the course of the investigations. Altogether the experiments conducted are of a highly scientific value, and leave little or no margin for error. The application of both the intradermal and ophthalmic tests is of a double order. In the intradermal a preliminary

[1] "Tuberculin Tests in Cattle, with Special Reference to the Intradermal Test." No. 94 Special Report Series of the Medical Research Council. Pp. 196. London: H.M. Stationery Office. 1925. Price 3s. net.

or sensitizing injection is given, and forty-two to seventy-two hours (usually forty-eight hours) after the first dose a test dose is administered, the area for the injection being in the neck, and the dosage employed in each instance being 0·1 c.c. The ophthalmic test is applied concurrently as a double instillation, the first sensitizing and the second as test, one drop of undiluted tuberculin being employed for the sensitizing, and two to five drops for the second instillation. The combined intradermal and ophthalmic methods would appear to be particularly advantageous for the testing of young animals, overcoming the difficulties with regard to the vagaries of temperature experienced in these animals under the subcutaneous method. It also bids fair to defeat the practice of "doping" by subcutaneous injections of tuberculin to inhibit or mask reaction when testing on sale of animals is required. Prominence is given in the report to the wide differences which exist in veterinary tuberculins in current use, and the necessity for a proper system of standardization. Obviously where there is variability in potency in tuberculin used, the value of a test under any method is discounted, and error is apt to occur. A method of standardization is recommended in the report, and the good work of the Committee will be further proved by putting this aspect of tuberculin testing on a satisfactory basis.

MAJOR-GENERAL SIR JOHN MOORE, A.V.S. (retd.).

TUBERCULOUS INFECTION IN MAN.

"*Immunité et Allergie! Notions obscures qui n'ont vraiment pas projeté de lumière dans le domaine clinique ou nous vivons tous les jours.*" This aphorism, culled from the Preface written by M. le Professeur Agrégé E. Leuret as an introduction to Dr. Aubertin's new book, will suffice to show the line taken by the author in dealing with the development of tuberculous infection in man.[1] M. Aubertin commences with a concise and clear account of what he conceives to be the "Immunity" theory of tuberculosis, a theory with which, however, he does not agree. We have nothing but praise for this little summary, which is in many respects better than some of the accounts of the matter given by advocates of the theory in question. There is, perhaps, a tendency to express, in terms rather too precise, conceptions which are still necessarily somewhat vague; but this is less the fault of the author than of the beautifully definite French language which he uses so well. It is true that M. Aubertin is, to judge by the referata, but little familiar with the work of English, American, and German students of tuberculosis, but he appears to be widely read in the numerous and excellent French contributions to the subject. After this preliminary sketch of what he considers to be the accepted view of the rôle of immunity in tuberculosis, he goes on to suggest that it is far from satisfactory as a working theory in relation to the disease in man. Perhaps his best criticism is to be found on p. 86, where he sets forth in a few crisp sentences several weighty objections to the "Immunity Theory," objections which might, at first sight, appear almost conclusive to "the man in the street." This passage deserves to be translated in full, because it raises some fundamental questions in connection with tuberculosis. He has been dis-

[1] "Le Developpement de l'Infection Bacillaire chez l'Homme: Le Rôle du Terrain." By Dr. E. Aubertin, Interne des Hôpitaux de Bordeaux. Pp. 339. Paris: Octave Doin. 1924. Price 20 frs.

cussing the question of reinfection in guinea-pigs, as to which his conclusions, though open to question, need not be quoted. He proceeds: "In man, on the contrary, the bacillary infection is usually contracted in an insidious form in early childhood, and in the great majority of cases it remains latent—a first point of difference, as we have just seen, from the experimental tuberculosis of guinea-pigs. But, further, it would be logical to expect that in adult age, the age of super-infections, the age of what people call immunity, the age of 'resistance,' new infections should, as in the animal, give rise only to transitory phenomena, leaving the original infection to remain latent as before. Instead of this, the 'age of immunity' is also the age at which, each year with increasing severity, this terrible scourge makes its most cruel ravages. . . . It is to be feared rather than praised, this so-called 'immunity,' which substitutes for the latent forms or curable localizations of childhood the more or less rapid 'consumptions' of the adult, before which the resources of science are powerless." There is only one obvious flaw in this eloquent reasoning, and it is to be found in the sentence, "In the great majority of cases it remains latent." If there are forces at work which, in the almost universally infected adult populations of our Western civilizations, render the tuberculous process latent in the majority of cases, there may, after all, be something to be said for this redoubtable immunity. Is it not possible that Aubertin, like so many purely clinical workers, may, in his preoccupation with the cases under his care—so numerous, perhaps, and so severe—be blind to that wider field of humanity where healthy (though infected) men and women go about their business and their pleasure exempt from the ravages of clinical tuberculosis? This large body of healthy but infected persons constitutes, too, a strong argument against the views expressed about Koch's bacillus by Aubertin as follows: "Il n'aime ni les cellules malformées, ni les cellules infectées, ni les cellules détériorées; il lui faut des tissus sains et il les aime d'autant mieux qu'ils sont davantage dans la plénitude de leur vitalité." There are numerous errors in the line of argument which Aubertin, in his desire to "show up" what he regards as the fallacies of such savants as Calmette, Borrell, Rist, L. Bernard, and others, is compelled to adopt. To explain, for instance, the frightful ravages of tuberculosis amongst the Senegalese troops on arrival in France during the war, he has recourse to the statement that these troops were exposed to "much heavier contaminations than our European populations" (p. 119). He paints a vivid picture of the transmission of infection from man to man amongst these natives. "The Senegal native, whether sick or healthy, is in the habit of using his fingers instead of his pocket-handkerchief, and if he happens to be tuberculous, and if he is bringing up bacillary sputum, his hands are constantly soiled with bacilli. From hand to hand the bacilli pass with ease. It is hardly possible to get these soldiers to wash their hands before each meal. As a matter of fact, the meal is partaken of by groups of six or eight men around the same *gamelle*." Yes, but supposing that the men are at first free, or almost free, from tuberculosis, as would appear to have been the case with Borrel's groups, since only 3 per cent. reacted to tuberculin, where are the bacilli to come from in such large quantities, and how long a time must elapse before this "hand-to-hand" method becomes capable of spreading massive infection? As a matter of fact, one of the charac-

teristic features of the pulmonary tuberculosis of the Senegalese was the small amount of sputum produced and the rarity of positive findings therein. How far their nasal discharges were contaminated it is hard to say; but nasal discharges are not, as a rule, heavily infected with tubercle bacilli. And yet the numbers of these men that died of tuberculosis *within twelve to eighteen months of arrival in France* was appalling by comparison with the low tuberculosis death-rate amongst their European comrades. M. Aubertin's hypothesis of "exposure to massive contamination" as the explanation of the susceptibility to tuberculosis amongst the Senegalese troops has no foundation in fact. As a matter of fact, so susceptible were these natives, that even the very slightest exposure to tuberculous infection was sufficient to lead, in many of them, to rapid and usually fatal disease. It is much more pleasant to praise than to criticize, and we may truly say of M. Aubertin's volume that it is well written, that it raises a great many questions of interest and importance, and that its perusal has given us much pleasure. It is necessary to add that the case made against the "Immunity Theory" of tuberculosis is far from being convincing, and that no evidence is adduced to prove the theories substituted for it—loss of activity of the lymphatic tissues in adult life, and "antipathy" of diseased and dystrophic tissues to tubercle bacilli. These theories appear to the reviewer to be quite untenable, either from the clinical or the pathological point of view.

S. Lyle Cummins.

TUBERCULOSIS OF THE EYES.

Dr. Arnold Löwenstein has recently issued a useful handbook on tuberculosis of the eyes, which merits the consideration not only of ophthalmic surgeons, but of all serious students of tuberculosis.[1] There are, indeed, few diseases of the eyes which are more destructive than tuberculosis, and for that reason it is fortunate that the disease is comparatively rare. Its rarity makes it of the greater interest. There is additional difficulty, owing to lack of familiarity, in making a correct diagnosis; and the variety of the conditions due to the infection of the several parts of the eye enhance this difficulty. The study of these lesions becomes therefore of the greater importance, for they are not amenable to the usual means of medication, as, for example, syphilitic lesions, but require lengthy treatment by measures of general hygiene for their overcoming. Even at best the prospects for complete cure are often poor owing to generalized lesions of the body which are not infrequently primary to the eye infection, and render cure difficult, if not impossible. The lids are affected mostly in association with lupus of the face; the lesion is of a most destructive character, and leaves the grossest of deformities. In the worst cases the lids may be absorbed in the scar tissue, so that the eyes are left entirely exposed, with the result that there is gradual deterioration of the cornea, and eventual blindness for all general purposes. Less general infections of the eyelids are found which assume a character which may lead to an erroneous diagnosis of rodent ulcer, and to the removal of the eye-

[1] "Die Tuberkulosis des Auges Ein Lehrbuch für den Pratiker und den Augenarzt." By Dr. Arnold Löwenstein, Professor of the German University in Prague. Pp. 84, with twenty-six illustrations. Berlin: Urban and Schwarzenberg, Friedrichstrasse 105B. 1924. Price G.M. 2.40.

lids. Only very careful microscopic examination of sections of the growth before radical operation can determine the true nature of the disease, and even then decision is not easy, for sections of tissues full of hair follicles are apt to produce effects which may be difficult of interpretation. The conjunctiva may be affected in either of the preceding states, or alone. In either circumstance there are growths in the fornices of a rich granular order, which rapidly caseate and leave indolent ulcers. The cornea is likewise affected in a chronic superficial change and in interstitial keratitis. Tuberculous iritis is, however, not found associated with these states. Disease of all parts of the uvea, as also of the sclera and episclera, are nearly always connected with some other bodily tuberculous lesion. Maybe this is difficult of demonstration; it may remain undiscovered after the most exhaustive examination by a team of physicians and surgeons, each of whom is well capable of determining any aberrant condition of the several organs under investigation. But when the case is kept under observation for a sufficiently long time, the ultimate source of the infection of the eye is usually revealed, sometimes long after the subsidence of the ocular infection. It may be urged in such cases as these that there is no proof of the primary and secondary nature of the respective lesions. That is true, but there is strong presumptive evidence that the greater and more generalized lesion is likely to be the primary focus of infection. Tuberculous keratitis, without other defined lesions due to tubercule, is always a subject of difficulty; the clinical symptoms are so much akin to those of the more common syphilitic interstitial keratitis, either of hereditary or acquired character, that diagnosis is extremely uncertain. Indeed, it is made mostly by a process of exclusion; the tuberculous condition is to some extent assumed in the absence of positive evidence that it is not due to other and commoner causes. The difficulty of diagnosis is intensified in the case of choroiditis in the adult and juvenile subject. There is no definite sign in the lesion itself; both separate lesions and multiple lesions may be found in indubitable tuberculous subjects, and identical lesions where there is no such certainty of general tubercle in syphilitic subjects, and where there is no positive proof of a syphilitic affection. The diagnosis is on a totally different plane to that of the severe cases of infantile meningeal tubercle, where the end symptoms are often discoverable in the eye by the presence of miliary tubercles. Apart from these severe conditions, which are in very many cases demonstrably tuberculous in origin, there are other ocular lesions which have at various times been held to be scrofulous, or paratuberculous, or unrelated to tubercle. Chief amongst these is the well-known phlyctenular conjunctivitis and keratitis of poor and ill-fed children. The lesions themselves vary greatly; they may be slight and of short duration, or severe and of prolonged duration, with the resultant of considerable damage to sight. The actual relation of these lesions has been long subject to debate, the supporters and antagonists of the tuberculous or paratuberculous theory of origin being about equally balanced, and able to bring about equal weight of evidence to support their respective theses; but the decision is not yet. This brief sketch of ocular conditions due to tubercle will serve to show what a volume of work there is still to be done before we are sure of our ground, and much of the difficulty arises from the (fortunate) rarity of the cases. Our thanks are due to Dr. Arnold Löwenstein for

his admirable monograph. It is well written, wisely balanced, and effectively illustrated. It may be commended to every student of tuberculosis, and particularly to those interested in eye work. There is a very fair bibliography.

N. Bishop Harman, M.A., M.B. (Cantab.), F.R.C.S. (Eng.).

A CLINICAL STUDY OF PULMONARY TUBERCULOSIS.

Professor Neumann has published a new work which deserves the serious study of all interested in the medical aspects of the tuberculosis problem.[1] The volume is a sequel to a previous one dealing with the physical examination of the chest. In it the author discusses with considerable detail the varied appearances of tuberculous disease of the lung and its manner of spread. He classifies his cases according to their clinical and pathological behaviour, and his conclusions should be of service both in prognosis and in treatment. Dr. Neumann lays considerable stress on the mode of extension of the disease in the body; this may be either by lymphatic and vascular channels, or by direct extension through the respiratory and alimentary tracts. Lymphatic spread, he holds, is typical of the majority of cases of pulmonary tuberculosis associated with surgical manifestations; although multiple foci are the rule, this form is relatively benign. The pleura and peritoneum are frequently involved, and the opinion is expressed that effusion into either of these cavities considerably increases the immunity to the disease. The vascular mode of spread is seen in a most virulent form in acute miliary tuberculosis. Sometimes benign types occur, such as the discrete miliary tuberculosis of the apex of one lung, which appears often to heal spontaneously and without being associated with any severe symptoms. Cases which spread by the "intracanalicular" route give the most typical cases of pulmonary tuberculosis. For this to take place there must be a tendency for the original focus to ulcerate and discharge its infected contents into the respiratory passages, from which it may gain access to the larynx and the digestive tract. Professor Neumann observes that moist sounds first appearing in the neighbourhood of the coracoid process are frequently associated with a bad prognosis. Examination of the spleen is considered to be important, enlargement of that organ being commonly associated with the vascular type of spread. With regard to treatment, the author is devotedly adherent to Koch's "Old Tuberculin," but admits that acute miliary tuberculosis fails to respond even to this remedy. In cases of the vascular type of disease he goes so far as to say that in young persons greater benefit is derived from specific therapy (*i.e.*, tuberculin) than from sanatorium treatment. The book is well illustrated with case-notes and charts so that the reader, although he may not always agree with the author's theories and conclusions, will at least be able to profit by his wide experience and careful clinical methods.

Andrew Morland, M.B., B.S. (Lond.).

[1] "Die Klinik der Beginnenden Tuberculose Erwachsenen"—II. "Der Formenkreis der Tuberculose." By Professor Dr. Wilhelm Neumann. Pp. vi + 265. Vienna vi.: Julius Springer, Amerlingstrasse 17. 1924. Price $2; G.M. 8.40.

MANUALS FOR MEDICAL ADVISERS AND WORKS OF REFERENCE.

"THE MEDICAL ANNUAL" is now in its forty-third year and fully maintains its unique position as the general practitioner's indispensable year-book.[1] The Editors are assisted by twenty-eight expert contributors. In addition to the alphabetically arranged signed sections, there is much miscellaneous matter invaluable for ready reference. There is a useful directory of sanatoria. Tuberculosis receives prominent consideration. Professor W. H. Wynn contributes a lengthy summary of recent work on the medical aspects of pulmonary tuberculosis, while Mr. A. Tudor Edwards treats of its surgical aspects, and provides a plate giving a series of coloured figures of pneumothorax with adhesions. Sir W. I. de C. Wheeler deals with various forms of surgical tuberculosis, and Dr. A. Rendle Short describes tuberculous peritonitis.

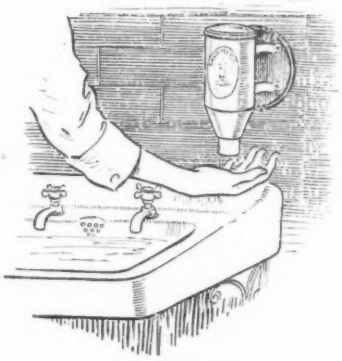
The seventh edition of "The Medical Who's Who"[2] has just been issued and provides a novel, interesting, and serviceable directory to most of the "legally qualified"—*i.e.*, "registered"—practitioners of this country. The volume is effectively produced with two columns to each page, and gives essential facts with regard to each personality in wisely ordered form. The volume is issued with the highest official medical endorsement. The work is indeed a monument of methodical organization and scientifically-directed editing, and all concerned in the preparation of this handsome and useful reference work are to be congratulated. The volume in addition to its main directory contains an index of names geographically arranged, and also lists of medical journals and principal London hospitals with their telephone numbers. It is intended that this practical publication shall be issued annually in future, and certainly the excellence of this year's edition affords a guarantee which should insure the successful accomplishment of this promise.

[1] "The Medical Annual: A Year-Book of Treatment and Practitioner's Index." Edited by Carey F. Coombs, M.D., F.R.C.P., and A. Rendle Short, M.D., B.S., B.Sc., F.R.C.S. Forty-third year of publication. Pp. xcvi+608+151, with 38 plates and 149 figures. Bristol: John Wright and Sons, Ltd. 1925. Price 20s.

[2] "The Medical Who's Who." Seventh Edition. Pp. lxiv+770. London: Grafton Publishing Company, Ltd., 8, Stone Buildings, Lincoln's Inn, W.C. 2. 1925. Price 30s. net.

PREPARATIONS AND APPLIANCES.

THE SAVONETTE is a very desirable sanitary adjunct for the bathroom and lavatory.[1] It is particularly useful for service in hospitals, sanatoria, and places where tuberculous and other sick folk are to be found, although as a prophylactic agent it is to be recommended for hotels, clubs, schools, and all institutions, as well as for private dwelling-houses. The chief features of this ingenious appliance are shown in the accompanying figure. It is a simple, economic, neat, automatically worked receptacle for powdered soap. All the user has to do is to wet the hands well with water, and then release the soap by pressing upwards the ring at the bottom of the savonette. In this way a small quantity of fresh soap is available for every user. It is guaranteed never to get out of order.



THE SAVONETTE.

The Walberswick Peasant Pottery Company, Ltd., are now supplying an artistic series of TABLE MATS admirably fitted for use at mealtimes in sanatoria and open-air schools.[2] They are made of cork and decorated by hand, and are supplied in round, oval, and oblong shapes, singly and in sets. These mats are heat proof, and are easily cleaned. Both sound and sick folk will appreciate these table protectors and aids to artistic decoration. The same firm also furnishes artistic little trays admirably adapted for the use of invalids.

SYRUP COCILLANA COMPOUND is a wisely devised combination of various drugs which experience and experiment have shown to be of special service in cases of catarrh of the respiratory tract where there is hard, dry, irritable cough, scanty expectoration, and general depression. This long-approved preparation will be found of considerable service in dealing with cases of pulmonary tuberculosis of bronchial type and accompanied by troublesome cough.[3]

Catarrhal states of the respiratory track oftentimes seem to prepare the way for tuberculous infection, and certainly the discomfort of many consumptives is increased by the prevalence of congested and inflamed states of the mucous membrane of nose, throat, and bronchi.

[1] The Savonette is made by the Savonette Company, 97, Caledonian Road, King's Cross, N.W. Price 12s. 6d.; special white enamel model, 15s.; refills, 6d.

[2] Full particulars with prices of the Dinner Mats can be obtained from the Walberswick Peasant Pottery Company, Ltd., 12, Holland Street, Kensington, W. 8, and Walberswick, Suffolk.

[3] Syrup Cocillana Compound is supplied to the profession by Parke, Davis and Co., 50-54, Beak Street, Regent Street, W. 1, from whom particulars can be obtained on application.

For the treatment of such conditions the PINOLEUM NEBULIZER OUTFIT provides a very useful agent, which experience in all parts of the world has approved.[1] The constituents of the inhalant have been proved experimentally to have considerable germicidal powers, inhibiting the growth of organisms now known to be causal agents in the production of catarrhal states and many of the mixed infections which complicate so many cases of tuberculous infection. A pinoleum brand of solidified inhalant, containing menthol, camphor, oils of eucalyptus, cassia, cinnamon, pine needles, together with refined petrolatum, is now available, and is a very serviceable application in catarrhal conditions of the nasal passages.

COLLOSOL PREPARATIONS are now available in a reliable series, and are proving very efficacious in the treatment of a number of various disorders, some of which are commonly met with in tuberculous patients. We would particularly direct attention to the excellent Collosol Sulphur Baths, Collosol Ichthyol, and Collosol Iodine Oil.[2]

Under the general title of STERAID there is now available a reliable series of absorbent and medicated gauzes and lints for use as surgical dressings. Each dressing is stored in a patent container, and only the amount required is drawn out and detached, thus making for effectiveness, economy, and convenience. Various forms, plain and medicated, of both lint and gauze can now be obtained in these scientifically devised cartons.[3]

PINE TAR SKIN SOAP is an excellent cleansing agent for the healthy, and a useful preparation for many delicate skins and subjects of cutaneous irritation.[4] It will be found serviceable for patients who readily react locally to sun and light treatment. The soap is available in several forms, including use for shaving and shampoo.

NONSPI is an American preparation, which is applied externally to the axillæ in cases of excessive and objectionable local sweating leading to discomfort, local irritation, and soiling of garments.[5] It is said to have antiseptic and deodorizing properties, and to be harmless.

GARLIC has for long been employed as a medicinal agent. Its active principle is an essential oil, ALLYL SULPHIDE, $(C_3H_5)_2S$, and to its action is generally ascribed the supposed serviceable properties of garlic. Various forms of garlic have from time to time been advocated in the treatment of tuberculosis. Those desiring to make trial of garlic in any of its forms can now secure reliable preparations from Messrs. Allen and Hanburys.[6]

[1] The Pinoleum Brand Products are made by the Pinoleum Company, New York City, U.S.A. The British Agents are Crooks and Warburton (A.D.S. Co.), Ltd., 40-42, Lexington Street, W. 1.

[2] Particulars regarding the different Collosol Preparations for use with tuberculous subjects may be obtained on application to the Crookes Laboratories (British Colloids, Ltd.), 22, Chenies Street, Tottenham Court Road, W.C. 1.

[3] Particulars and prices of the Steraid Dressings can be obtained on application to the manufacturers, Robert Bailey and Son, Ltd., Marriott Street Mills, Stockport. London Office: 307, Sentinel House, Southampton Row, W.C. 1.

[4] The Pine Tar Skin Soap is manufactured by Thomas Reid and Sons, Ltd., Smith Street, Kinning Park, Glasgow.

[5] Nonspi is manufactured by the Nonspi Company, 2615-17, Walnut Street, Kansas City, Missouri, U.S.A., and specimens and particulars will be sent on application.

[6] Messrs. Allen and Hanburys, Plough Court, 37, Lombard Street, E.C. 3, and 7, Vere Street, Cavendish Square, W. 1, will be glad to forward particulars on application from any medical practitioner.

THE OUTLOOK.

NOTES AND RECORDS.

As announced in our last issue the Eleventh Annual Conference of the National Association for the Prevention of Tuberculosis will be held in the Robert Barnes Hall of the Royal Society of Medicine, 1, Wimpole Street, W. 1, on Monday and Tuesday, July 6 and 7.[1] The Minister of Health has sanctioned the expenses of three delegates each from County Councils, County Borough Councils, Metropolitan Borough Councils, and Joint Committees for Tuberculosis. The fee of one guinea per delegate includes a copy of the Transactions. Arrangements have been made with the railway companies of Great Britain to issue return tickets to London for a single fare and a third, available from July 4 to 8. The discussion on "Tuberculosis in Childhood" will be opened by Professor Pirquet, followed by Dr. Stanley Griffith, Dr. Richard Wagner, Professor Sir Robert Philip, Dr. Clive Rivière, Professor A. Louise McIlroy, Dr. Fergus Hewat, Sir Henry Gauvain, Dr. John Fraser, Dr. Gordon Pugh, and others. A discussion on "The Treatment of Tuberculosis by Sanocrysin" will be opened by Professor Holger Mollgaard, followed by Professor Knud Faber, Professor Lyle Cummins, and others. At the Annual Meeting of the Association films will be shown, including one entitled "The Invisible Enemy."

The Annual Meeting of the Tuberculosis Society[2] will be held on Tuesday, July 7, at Pritchard's Restaurant, 79, Oxford Street, W. 1. The meeting will be preceded by a dinner (tickets 5s. 6d.) Nominations for the offices of President, Honorary Secretary, and Honorary Treasurer should be sent in to the Honorary Secretary at once.

The Davos Research Institute is arranging for a climatological congress dealing with the significance of climate in its physical, physiological, and therapeutical aspects to be held at Davos, August 17-22. Professor Loewy and various Swiss specialists from Davos and other parts of Switzerland will participate. Prominent scientists from various countries have also promised to take part.[3]

From October 9 to 16 a post-graduate course on tuberculosis will be held at the Faculty of Medicine of Strasburg, under the auspices of the Anti-Tuberculosis Association of Alsace and Lorraine. A programme of lectures and practical demonstrations dealing with many aspects of tuberculosis has been prepared by Dr. Vaucher, assisted by numerous other members, of the University of Strasburg, from whom particulars may be obtained at the Headquarters of the Association Alsacienne et Lorraine Contre la Tuberculose, 22, rue de l'Université, Strasburg.

[1] Full particulars can be obtained on application to the Secretary, Miss Freda Strickland, 20, Hanover Square, W. 1.

[2] Particulars regarding the aims and work of the Tuberculosis Society can be obtained on application to the Hon. Secretary, Dr. Frederick J. C. Blackmore, 138, Herbert Road, Woolwich, S.E. 18.

[3] Full particulars may be obtained from the Hon. Secretary, Dr. Vogel-Eysern, Sanatorium Solsana, Davos-Dorf.

In the two handsome and intensely interesting volumes, "The Life of Sir William Osler," recently issued, there are numerous references to the inspiring influence and abundant services of this great master of medicine in furthering the Anti-Tuberculosis Movement both in America and in this country.[1]

The Council of the National Sanatorium Association on May 30 entertained delegates of the conference of the Post Office Sanatorium Society at the National Sanatorium, Benenden. A memorial tablet to the late Dr. T. D. Lister was unveiled by the chairman of the Council, Mr. R. E. V. May, who referred to the services of Dr. Lister to the Benenden Sanatorium and to the anti-tuberculosis movement in general. A tablet placed in the entrance-hall bears the following inscription: "Erected by the Council of the National Sanatorium Association, Benenden, Kent, to commemorate the untiring zeal and devoted service of Thomas David Lister, C.B.E., M.D., M.R.C.P., one of the founders of this institution, and for seventeen years advisory physician to the Council, who by his personal sympathy endeared himself to all. Born January 30th, 1869; died July 30th, 1924."

The Eighteenth Annual Report of the King Edward VII. Sanatorium, Midhurst, Sussex, has recently been issued, and contains a series of tables and departmental records, together with statistical returns indicating ultimate results.

The fortieth Report of the Trudeau Sanatorium recently issued is an impressive record, containing illustrations of the place and fine portraits of Trudeau and those who as colleagues, supporters, trustees, and friends have made this great institution a place of world-wide renown.[2]

At the last examination held by the Society of Superintendents of Tuberculosis Institutions five nurses passed from Market Drayton, five from Pinewood, three from Highwood Hospital, two from the East Anglian Sanatorium, five from Sunderland Borough Sanatorium, five from Colindale Hospital, one from Godalming, and one from The Downs, Sutton.[3]

The Veterinary Journal for April last is a "Special Tuberculosis Number," and contains a particularly valuable series of original communications from experts, including Dr. M. C. Guerin of the Pasteur Institute, Lille, Dr. Nathan Raw, Dr. A. Stanley Griffith, Lieutenant-Colonel J.W. Brittlebank, Mr. G. P. Male, Dr. R. Stenhouse Williams, Mr. J. S. Lloyd, Professor S. Lyle Cummins, Major-General Sir John Moore, and Principal A. W. Whitehouse.[4]

The English Review for May contains an interesting and informing short article by Dr. Leonard Hill on "Sun and Artificial Sun Baths."[5]

The Ministry of Health have recently issued a "Memorandum on the Duties of Medical Officers of Health in England and Wales" (price 2d). There is a section dealing with tuberculosis.

[1] "The Life of Sir William Osler," by Harvey Cushing, in 2 vols. Oxford: The Clarendon Press. 1925.

[2] The Fortieth Annual Report of the Trudeau Sanatorium, formerly Adirondack Cottage Sanatorium, Savanac Lake, Trudeau P.O., New York.

[3] Particulars regarding the examinations held by the Society of Superintendents of Tuberculosis Institutions can be obtained on application to the Hon. Secretary.

[4] *The Veterinary Journal*, edited by Professor Frederick Hobday, C.M.G., F.R.C.V.S., F.R.S.E., is published monthly by Baillière, Tindall and Cox. Price 2s. each number. Annual subscription, 21s.

[5] *The English Review* is published monthly at 4, Dean's Yard, Westminster Abbey, S.W. Price 1s. net each number.